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A REVIEW AND EVALUATION

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AIRMAN CLASSIFICATION BATTERIES FROM 1948 TO 1975:

A REVIEW AND EVALUATION

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This technical report has been reviewed and is approved.

LELAND D. BROKAW, Technical Director
Personnel Research Division

Approved for publication.

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From 1948 to 1975, the United States Air Force employed ten different multiple aptitude batteries for the purpose of either classifying or selecting and classifying nonprior service enlistees. Each of the different batteries is described and evaluated in terms of standardization, reliability, and validity.

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PREFACE

The work reported in this study was accomplished under Project 7719, Air Force Personnel System Development on Selection, Assignment, Evaluation, Quality Control, Retention, Promotion, and Utilization; Task 771910.

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I. INTRODUCTION

The most effective use of available personnel is the basic goal of every organization. When an individual is placed on a job for which he is not prepared, the result is frustration for the individual, expense to the organization, and a waste of manpower. Consequently, over the past thirty years, psychological testing has come into increasing use as a guide to better personnel administration. The primary reason for the use of tests is that it costs less to test a man than to attempt to train him and discover he is untrainable.

Testing programs have been applied to basically two administrative tasks. The first is personnel selection wherein the most qualified job applicants are chosen from those available on the basis of interpersonal differences. The second task is the more complex one of personnel classification. An attempt is made to assign each selected applicant on the basis of intrapersonal differences to the job in which he can most effectively serve. The ultimate goal for both procedures is the same, to maximize the effectiveness of the organization.

From 1948 to the present, the United States Air Force has employed multiple aptitude batteries for the purpose of classifying nonprior service enlisted personnel. During this period of time, ten different operational batteries have been used. Some of the batteries represent only minor revisions of the previous one; others reflect major changes in the Airman Testing Program. The report which follows is both a review and an evaluation of each of the aptitude batteries.

II. THEORY OF CLASSIFICATION

The fundamental postulate, which has served as the basis for the development of the classification batteries, is that each Air Force job specialty requires a specific pattern of aptitudes for success. If the major aptitudes common to the various specialties can be separately measured, it would be possible to predict each applicant's probable success in any job specialty by means of an empirically weighted composite score based on those tests measuring aptitudes necessary for that specialty. Since it is not administratively feasible to produce a composite score for every Air Force job, those jobs requiring similar patterns of aptitudes are combined and composite scores are produced which are predictive of success in homogeneous clusters of jobs. Originally, job clusters were developed on the basis of subjective judgement and job analysis data. As additional empirical information became available, the clusters were rearranged so that they were more homogeneous.

III. AIRMAN CLASSIFICATION BATTERY, AC-1A

Research in support of the Airman Classification Program began in 1946. Many of the test ideas and psychometric techniques employed resulted from the Army Air Forces Aviation Psychology Program of World War II. Batteries of aptitude tests were used to select aviation cadets for pilot, navigator, or bombardier training. As a result of this inaugural program, much time was saved in the development of aptitude tests for classifying enlisted personnel. By January 1947, an experimental battery had been developed and was being routinely administered to basic trainees for validation. In November of 1948, the first operational battery, the airman classification battery (AC-1A), was officially accepted for assigning Air Force enlistees to various job specialties.

Description

AC-1A consisted of twelve aptitude tests and a biographical inventory (BI) to which six keys were applied. Table 1 presents the time limit, number of items, and scoring formula for each test of the battery. A description of the material in each instrument can be found in Appendix A. From the thirteen tests, eight

Table 1. **Tests of Airman Classification Battery, AC-1A**

Tests	Testing Time[a]	Number of Items	Scoring Formula
Word Knowledge	12	30	R-W/4
Arithmetic Reasoning	15	20	R-W/4
Dial and Table Reading[b]	10	143	R-W/4
Numerical Operations[b]	6	78	R-W
Aviation Information	15	30	R-W/4
Background for Current Affairs	20	30	R-W/4
Electrical Information	18	30	R-W/4
Mechanical Principles	12	15	R-W/4
General Mechanics	20	30	R-W/4
Tool Functions	12	20	R-W/4
Speed of Identification[b]	4	48	R-W
Memory for Landmarks	9	36	R-W
Biographical Inventory	50	125	R-W+40

Note. — The total administration time (excluding breaks) is approximately 5 hours and 20 minutes. Table 1 was adapted from Gragg and Gordon (1951), pp. 65-66.

[a] Time limits are given in number of minutes of actual testing time.

[b] Speed test

composite scores, called aptitude indices (AI), were derived each of which consisted of different combinations of differentially weighted tests. The AIs were used to predict success in seven homogeneous job clusters [Mechanical (M), Clerical (Cl), Equipment Operator (EO), Radio Operator (RO), Technician Specialty (TS), Services (S), and Craftsman (Cr)] and a single specialty, Technical Instructor (I). Table 2 presents the test composition of each AI.

Battery Development

Many of the aptitude tests used in AC-1A issued directly from the Aviation Psychology Program and were adapted to the airman population. Others were specially developed to measure areas of performance related to one or more job clusters. In the development of each aptitude measure, the goal was to attain a maximum amount of reliable, homogeneous, predictive variance in a minimum amount of testing time. Test homogeneity was achieved by selecting items which were highly correlated with total test scores.

For the BI, a different developmental procedure was followed. The instrument was scored with six different keys. The items and item responses of the inventory which constituted a particular key were selected on the basis of their validities for an external criterion. If an item response evidenced a significant positive correlation for a criterion, it was keyed +1.00. If the correlation was significant and negative, it was keyed -1.00. Five empirical keys were developed. Technical school course grade served as the criterion in the development of the keys for the Mechanical, Clerical, Radio Operator, and Craftsman AIs. Job proficiency rating was the criterion employed in the development of the Instructor key. The Equipment Operator key was devised by rational means. it consisted of item responses which indicated either experience or interest in operating heavy machinery.

Norms

In May and June of 1947, approximately 15,000 basic trainees were tested with AC-1A, the Army General Classification Test (AGCT-1C), and the Army Mechanical Aptitude Test (MA-2). A random

Table 2. **Test Composition of Each Aptitude Index[a] of AC-1A**

Tests	Aptitude Indices							
	M	C1	EO	RO	I	TS	S	Cr
Word Knowledge	--	X	--	--	X	X	X	--
Arithmetic Reasoning	X	X	X	X	X	X	X	X
Dial and Table Reading	X	X	X	X	X	X	X	X
Numerical Operations	--	X	--	X	--	X	--	--
Aviation Information	X	--	--	--	--	X	--	X
Background for Current Affairs	--	X	--	--	X	X	--	--
Electrical Information	X	--	--	X	--	X	--	X
Mechanical Principles	X	--	--	--	--	--	--	--
General Mechanics	X	--	X	--	--	--	--	--
Tool Functions	X	--	X	--	--	--	--	--
Speed of Identification	--	--	--	X	--	--	--	X
Memory for Landmarks	--	--	--	X	--	--	X	X
Biographical Inventory Keys[b]								
Mechanical (M)	X	--	--	--	--	--	--	--
Clerical (C1)	--	X	--	--	--	--	--	--
Equipment Operator (EO)	--	--	X	--	--	--	--	--
Radio Operator (RO)	--	--	--	X	--	--	--	--
Instructor (I)	--	--	--	--	X	--	--	--
Craftsman (Cr)	--	--	--	--	--	--	--	X

Note. — Table 2 was adapted from Gragg and Gordon (1951), p.5.

[a]Tests weighted in each aptitude index are indicated (X).

[b]The BI is scored with a separate key for each AI in which it is weighted.

stratified sample consisting of 1,000 basic trainees was identified on the basis of AGCT-1C. Answer sheets for each AC-1A subtest were drawn for all 1,000 subjects, and means and standard deviations were determined. Standard scores in the form of stanines were developed by a process of preparing conversion tables with cut-off points one fourth of a standard deviation above and below the mean and at one half standard deviation intervals (Brokaw, Note 1). Gragg and Gordon (1951, p. 6) concluded that the use of this normative base "insured comparability of standard scores over a long period of time and avoided the marked cyclic changes (in aptitude) usually displayed by the airman population."

After initial standardization, the following subtests were shortened: Arithmetic Reasoning, Aviation Information, Background for Current Affairs, Electrical Information, Mechanical Principles, General Mechanics, and Tool Functions. As a result, it was necessary to develop new norms for each of the short-form tests. The norms were developed by the equi-percentile method. A description of this norming technique is provided in Ghiselli (1964, p. 89). For each short-form test, the long-form counterpart served as the norming reference measure. All tests were administered to a standardization sample consisting of 1,018 randomly selected basic trainees (Gragg & Gordon, 1951).

New norms were also developed for the BI keys and AIs. In each case, the equi-percentile procedure was followed. For the BI keys, the original Instructor BI served as the norming reference measure. For the AIs, the original Instructor AI was used as the reference measure. The standardization samples for the BI keys and AIs consisted of 760 and 582 randomly selected basic trainees, respectively (Gragg & Gordon, 1951).

Reliability

Since training assignments were based on composite scores rather than individual test scores, questions concerning reliability are most appropriately directed to the AIs. The correlation of sums formula

(Kelly, 1947, p. 395, formula 10:99) was employed to produce the reliability estimates presented in Table 3. A composite reliability coefficient derived by this formula is a function of the reliability of the test components, their variances, intercorrelations, and the respective weights assigned to them. Test-retest reliability coefficients were derived for each subtest. The composite reliabilities range from .89 to .96 with a median of .92.

Table 3. **Reliability Coefficients for the Aptitude Indices of AC-1A**

(N = 161 – 2,019 basic trainees)

Aptitude Index	Reliability
Mechanical	.95
Clerical	.95
Equipment Operator	.91
Radio Operator	.92
Instructor	.89
Technician Specialty	.96
Services	.92
Craftsman	.92

Note. — Table 3 was adapted from Gragg and Gordon (1951), p. 12.

Validity

The validation of AC-1A was accomplished by correlation techniques with technical school course grades as the criterion. The most serious problem encountered in the process of validation was that available validity samples consisted of basic trainees who had been subjected to various selection procedures at successive stages of training. Before the institution of the classification program, validity samples represented a range of ability that had been restricted only by preinduction selection procedures. After the classification program was in operation, validity samples represented a range of ability that had been restricted by both selection and classification procedures. Consequently, all validity coefficients were considered to be conservative. To correct for the restriction in range, a statistical formula provided by Thorndike (1949) was employed which was designed to yield validity estimates that would have been obtained from an unrestricted population. Table 4 presents corrected validity coefficients for validation studies of 29 separate technical school courses. The validities range from .32 to .77 with a median of .61.

Evaluation

Norms. Norms provide a basis for comparing scores made by different people on the same test or the same people on a different test. The adequacy of the norms is directly related to the representativeness of the base sample and the number of cases in it. By stratifying the AC-1A standardization sample on the basis of the AGCT-1C, it was possible to base the norms for AC-1A on the distribution of talent displayed by the World War II mobilization population (N = 11,694,229; Uhlaner & Bolanovich, 1952). During the emergency mobilization conditions of World War II, all able-bodied men who were not psychotic nor feeble-minded to a disabling extent were expected to serve (Brokaw, Note 1). As a result, the mobilization population represented very nearly the full spectrum of available talent and provided a superior normative reference base for the standardization of AC-1A.

Reliability. The AIs of AC-1A were sufficiently reliable for classification purposes. Even the Services index which was based on only four test components was highly reliable.

Validity. The 29 corrected validity coefficients reported in Table 4 resulted from validation studies employing technical school course grade as the criterion. Empirically derived job performance criteria were not available. The reported validities should be interpreted in light of this fact. The AIs were a suitable basis for assigning individuals to technical training, but they were sufficient for assigning individuals to jobs only to the extent that technical school grades were correlated with actual job performance.

Table 4. **Validity Coefficients[a] for the Aptitude Indices of AC-1A Corrected for Restriction of Range**

Aptitude Index	Technical School Course	N	r_c
Mechanical	Aircraft Maintenance	2,082	.68
	Airplane Electrical Mechanic	275	.61
	Airplane and Engine Mechanic (Conventional)	130	.73
	Airplane and Engine Mechanic (General)	469	.73
	Airplane Hydraulic Mechanic	157	.57
	Airplane Instrument Mechanic	164	.60
	Airplane Power Plant Mechanic[b]	300	.65
	Airplane Power Plant Mechanic[c]	95	.72
	Airplane Power Plant Specialist[d]	101	.50
	Airplane Power Plant Specialist[e]	239	.61
	Airplane Propeller Mechanic	133	.40
	Auto Equipment Technician	306	.61
	Primary Armament Technician	355	.77
	Radio Mechanic (General)	513	.66
	Remote Control Turret Mechanic	185	.63
	Teletype Mechanic	110	.32
Clerical	Clerk-Typist	1,965	.63
	Personal Equipment Technician	116	.33
	Supply Technician	414	.64
Radio Operator	Control Tower Operator	620	.66
	Radar Operator	518	.57
	Radio Operator (High Speed Manual)	91	.55
	Radio Operator	46 - 321	.49
	Teletype Operator	599	.52
Technician Specialty	Photo Interpretation Technician	88	.61
	Weather Observer	266	.55
Craftsman	Airplane Sheet Metal Worker	233	.67
	Fabric and Dope Mechanic	123	.64
	Powerman	264	.53

Note. — Table 4 was adapted from Gordon (Note 2).

[a]All validity coefficients are significant at the .01 level.

[b]Air Force job specialty code designation 68410.

[c]Air Force job specialty code designation 68413.

[d]Air Force job specialty code designation 68414.

[e]Air Force job specialty code designation 68416.

Validation studies for the Instructor and Equipment Operator AIs were not performed due to insufficient criterion data. Actual validity estimates for the Services AI are not available; however, validation studies indicated that its predictive efficiency was rather low for one set of Services jobs, food services specialties (Gragg & Gordon, 1951).

Examination of Table 4 reveals that the predictive validity of AC-1A was moderate for most specialties. The validities range from .32 to .77 with a median of .61. All validity coefficients presented are significant at the .01 level. Although the obtained validities were not extremely high, they do indicate that substantial positive relationships existed between AC-1A and technical school grades. AC-1A was of significant value in determining technical school assignments.

The primary objective of the classification program was to insure that every airman was assigned to some job specialty. In such a situtation, it is necessary not only to predict success accurately in each job cluster, but also to accurately predict differences in success for each cluster. The AIs must be valid and they must be valid differentially. The very basis of assignments was the differences in predicted success for the various job clusters. For example, if each of the separately developed composites were equally valid for each job family, differential predictions would be impossible. If the validity of a composite developed to predict success in a particular cluster was sufficient and the validities for the same job clusters of composites developed to predict success in other clusters were all zero, differential validity would be high. Accordingly, a measure of the differential validity of the battery is the extent to which the composite scores measure different functions. Composites which have low intercorrelations allow differential predictions. Highly correlated composites measure similar functions and would not provide the differentiation necessary for classification purposes. Table 5 presents the intercorrelations for the AIs of AC-1A. The coefficients range from .50 to .91 with a median of .81. The Clerical, Instructor, Technician Specialty, Services, and Radio Operator AIs were very similar. For purposes of differential predictions, there appeared to be too much overlap among the AIs of AC-1A.

Table 5. **Intercorrelations of the Aptitude Indices of AC-1A**

(N = 1,000 basic trainees)

Aptitude Indices	M	C1	EO	RO	I	TS	S	Cr
Mechanical (M)		.71	.76	.78	.75	.82	.76	.87
Clerical (C1)			.50	.88	.91	.90	.90	.75
Equipment Operator (EO)				.57	.58	.63	.61	.79
Radio Operator (RO)					.86	.83	.91	.86
Instructor (I)						.90	.90	.79
Technician Specialty (TS)							.90	.81
Services (S)								.83
Craftsman (Cr)								

Note. — Table 5 was adapted from Gragg and Gordon (1951), p. 16.

IV. AIRMAN CLASSIFICATION BATTERY, AC-1B

In December of 1949, airman classification battery (AC-1B) replaced AC-1A. Previous validity studies and experience in the Airman Classification Program had indicated the need for battery revision. The Instructor AI was eliminated and the Electronics Technician AI was included. Pattern comprehension, a new test variable, was added to the battery and weighted in three AIs. The Instructor BI key was withdrawn and Electronics Technician and Services keys were added. All other test variables remained the same; however, the AIs were revised in terms of the tests weighted in each.

Description

AC-1B consisted of thirteen aptitude tests and a BI to which seven keys were applied. The number of items, scoring formula, and time limit for each test are presented in Table 6. The total administration time (excluding breaks) was approximately 5 hours and 40 minutes. A description of each instrument can be found in Appendix A. From the fourteen test variables, eight AIs were derived and were used to predict success in eight job clusters. The subtests weighted in each AI are presented in Table 7.

Battery Development

The development of AC-1B included two major modifications and several minor ones. First, the Instructor AI was eliminated and the Technician Specialty composite was substituted in its place. The

Table 6. **Tests of Airman Classification Battery, AC-1B**

Tests	Testing Time[a]	Number of Items	Scoring Formula
Word Knowledge	12	30	R-W/4
Arithmetic Reasoning	15	20	R-W/4
Dial and Table Reading[b]	10	143	R-W/4
Numerical Operations[b]	6	78	R-W
Aviation Information	15	30	R-W/4
Background for Current Affairs	20	30	R-W/4
Electrical Information	18	30	R-W/4
Mechanical Principles	12	15	R-W/4
General Mechanics	20	30	R-W/4
Tool Functions	12	20	R-W/4
Speed of Identification[c]	4	48	R-W
Memory for Landmarks	9	36	R-W
Pattern Comprehension	12	20	R-W/4
Army Radio Code[d]	30	150	R-W/2
Biographical Inventory	50	125	R-W+40

Note. -- Table 6 was adapted from Gragg and Gordon (1951), pp. 65-66.

[a]Time limits are given in number of minutes of actual testing time.

[b]Speed tests.

[c]Speed of Identification, a speed test, was eliminated in January of 1953.

[d]Army Radio Code was added to the battery in January of 1953.

Table 7. **Test Composition of Each Aptitude Index of AC-1B**

Tests	Aptitude Indices								
	M	C1	EO	RO	RO[a]	TS	S[b]	Cr	ET
Word Knowledge	–	X	–	–	X	–	–	–	X
Arithmetic Reasoning	–	–	–	–	–	X	X	–	X
Dial and Table Reading	X	X	X	X	X	X	–	X	X
Numerical Operations	–	X	–	X	X	–	–	–	–
Aviation Information	X	–	–	–	–	X	–	–	–
Background for Current Affairs	–	X	–	–	–	X	–	–	–
Electrical Information	X	–	–	X	–	–	–	–	X
Mechanical Principles	X	–	–	–	–	–	–	–	–
General Mechanics	X	–	X	–	–	–	–	–	–
Tool Functions	–	–	–	–	–	–	–	X	–
Speed of Identification	–	–	–	X	–	–	–	–	–
Memory for Landmarks	–	–	–	X	–	–	–	X	–
Pattern Comprehension	–	–	–	–	–	X	X	X	–
Army Radio Code	–	–	–	–	X	–	–	–	–
Biographical Inventory Keys[c]									
Mechanical (M)	X	–	–	–	–	–	–	–	–
Clerical (C1)	–	X	–	–	–	–	–	–	–
Equipment Operator (EO)	–	–	X	–	–	–	–	–	–
Radio Operator (RO)	–	–	–	X	X	–	–	–	–
Services (S)[b]	–	–	–	–	–	–	X	–	–
Craftsman (Cr)	–	–	–	–	–	–	–	X	–
Electronics Technician (ET)	–	–	–	–	–	–	–	–	X

Note. — Table 7 was adapted from Gragg and Gordon (1951), p. 42.

[a]Revised Radio Operator AI, introduced in January 1953.

[b]Eliminated in April 1955.

[c]The BI is scored with a separate key for each AI in which it is weighted.

impetus for this modification was the high correlation between the two composites (r = .90; Gragg & Gordon, 1951, p. 16). The Technician Specialty AI could be used to assign trainees to the Technical Instructor career field with equivalent classification efficiency.

The second major modification was the addition of a new AI, Electronics Technician (ET). Research by Massey (Note 4) had indicated that the separation of the electronics related specialties from the Mechanical job cluster and the use of separate predictive composites for each would result in better prediction. Furthermore, the use of separate AIs would offset the large flow of manpower into the Mechanical job family and reduce the competition between the Electronics and Mechanical career fields for high aptitude personnel. There were five test variables included in the Electronics Technician composite: Arithmetic Reasoning, Dial and Table Reading, Electrical Information, Word Knowledge, and the BI. Each subtest was weighted evenly in the composite.

The BI key for the Electronics Technician composite was developed from the Mechanical and Equipment Operator BI keys. These keys were chosen because the Mechanical BI had shown positive correlations and the Equipment Operator BI negative correlations for success in electronics specialties. Item responses for the Mechanical key which were not included in the Equipment Operator key were weighted in the Electronics Technician BI. Item responses for the Equipment Operator key, which were not included in the Mechanical key, were also weighted in the Electronics Technician BI but the signs of the responses were reversed.

For AC-1A, the BI was not weighted in the Services composite. Accumulation of data after the introduction of the battery permitted the development of a BI key for the Services index. The key was developed on the basis of response validities obtained for an empirical criterion, job proficiency rating. The experimental Services BI produced a moderate but significant validity coefficient (r=.21; Gragg & Gordon, 1951, p. 45); consequently, it was included in the revised Services index.

Battery revision also provided the opportunity to include a new test variable, Pattern Comprehension. It was weighted in the Technician Specialty, Services, and Craftsman AIs as shown in Table 7.

On the basis of validity studies completed since the introduction of AC-1A, each AI was revised. Generally, revision of the AIs resulted in a reduction in the number of test components weighted in each composite.

Norms

The stanine standard score scale was maintained for AC-1B. The norms developed for the previous battery were used except for the new test variables and the Electronics Technician AI. The norms for Pattern Comprehension and the Electronics BI key were tied to those developed for AC-1A (Gragg & Gordon, 1951). The equi-percentile method was employed with Mechanical Principles and Dial and Table Reading as reference instruments for Pattern Comprehension (N = 1,018 basic trainees) and the Mechanical BI key as the reference instrument for the Electronics Technician BI key (N = 1,007 basic trainees).

The norms developed for the Services BI key were based on the theoretical percentages for each stanine. The standardization sample consisted of an unreported number of randomly selected basic trainees.

For the Electronics Technician AI, the norms were developed prior to the accumulation of a sample of actual raw composite scores. An apriori raw composite score mean was employed and a composite standard deviation was estimated from the intercorrelations and standard deviations of the tests weighted in the AI. These statistics were used to estimate the raw composite scores which would correspond to each stanine. Except for the extreme standard scores (1.00 and 9.00), each standard score interval consisted of one-half of the raw composite score standard deviation.

Reliability

Table 8 presents test-retest reliabilities for each AI of AC-1B. The interval between testing was approximately three weeks. The reliability estimates range from .68 to .93 with a median of .90.

Table 8. **Reliability Coefficients[a] for the Aptitude Indices of AC-1B**
(N = 297 basic trainees)

Aptitude Index	Reliability
Mechanical	.93
Clerical	.93
Equipment Operator	.86
Radio Operator	.91
Technician Specialty	.88
Services	.68
Craftsman	.88
Electronics Technician	.92

Note. — Table 8 was adapted from Massey and Creager (1956), p. 2.

[a]These data were obtained prior to the revision of the Radio Operator AI.

Validity

The validation of AC-1B was accomplished by correlation techniques with technical school course grade as the criterion. Table 9 presents corrected validity coefficients for 21 different technical school courses. The coefficients range from .34 to .77 with a median validity of .60.

Evaluation

Norms. For AC-1B, the norms employed were either the same as those used with AC-1A or norms developed on the basis of those used with AC-1A. Consequently, AC-1B norms were also tied to the broad range of talent displayed by the World War II normative reference base. There was, however, one exception. The norms for the Services BI key were developed by standard procedures for developing normalized conversion tables. The standardization sample employed in the development of these norms was not sufficiently described for evaluative purposes. Nevertheless, it is likely that the norms for AC-1B were a valuable means of score comparisons.

Reliability. The reliability of AC-1B was lower than that for AC-1A. However, the decrease in reliability was expected since the number of test variables weighted in each composite was reduced. With the exception of the Services AI which yielded a rather low reliability (R_{tt} = .68), the AIs of AC-1B were sufficiently reliable for classification purposes.

Validity. Technical school course grade was employed as the criterion in the validation of AC-1B. Empirically derived job performance criteria were not available; consequently, the usefulness of the battery for actual job assignments was contingent upon the strength of the relationship between technical school curricula and job performance.

The validities obtained for AC-1B were very similar to those for the previous battery, ranging from .34 to .77 with a median of .60. All validity coefficients presented in Table 9 are significant at the .01 level. On the basis of the data presented in Table 9, it is evident that AC-1B provided a valid basis for technical school assignments.

Table 10 presents the intercorrelations of the AIs for AC-1B. The coefficients range from –.06 to .85. Although battery revision resulted in a reduction in the level of intercorrelations, the composites remained highly interrelated as evidenced by the median correlation (r = .78). The AIs of AC-1B provided slightly better differentiation than those of the prior battery.

Table 9. **Validity Coefficients[a] for the Aptitude Indices of AC-1B Corrected for Restriction of Range**

Aptitude Index	Technical School Course	N	r_c
Mechanical	Aircraft and Engine Mechanic	838	.77
	Camera Repairman	232	.74
	Central Office Equipment Mechanic	138	.61
Clerical	Clerk-Typist	1,842	.60
Equipment Operator	Special Vehicle Operator*	448	.34
Radio Operator[b]	Teletype Operator	1,315	.52
	Communication Center Specialist[c]	444	.43
	Communication Center Specialist*[d]	402	.34
	Control and Warning Operator*	1,179	.52
	Control Tower Operator*	553	.46
	Radio Operator (General)*	1,372	.52
Technician Specialty	Photo Lab Technician	238	.65
	Military Police*	136	.60
Craftsman	Powerman	445	.71
Electronics Technician	Teletype Mechanic[e]	226	.63
	Teletype Mechanic[f]	190	.68
	Radio Mechanic (Air Equipment)	114	.61
	Armament Electronics	181	.76
	"A" Series Gun Bomb Rocketsight Mechanic	119	.51
	Turret System Mechanic	746	.76
	Radar Mechanic (Airborne)*	312	.36

Note. — The majority of the validities presented in Table 9 were adapted from Zachert and Ivens (Note 6). Validities for the courses indicated with an asterisk were adapted from Massey and Creager (1956), pp. 9-10.

[a]All validity coefficients are significant at the .01 level.

[b]These data were obtained prior to the revision of the Radio Operator AI.

[c]Air Force job specialty code designation 29130.

[d]Air Force job specialty code designation 29150.

[e]Air Force job specialty code designation 23900.

[f]Air Force job specialty code designation 36350.

Table 10. **Intercorrelations[a] of the Aptitude Indices of AC-1B**

(N = 913 basic trainees)

Aptitude Indices	Aptitude Indices M	Cl	EO	RO	TS	S	Cr	ET
Mechanical (M)		.55	.68	.69	.67	.08	.77	.82
Clerical (Cl)			.20	.80	.79	.28	.47	.80
Equipment Operator (EO)				.35	.39	-.06	.56	.38
Radio Operator (RO)					.77	.15	.65	.82
Technician Specialty (TS)						.32	.64	.85
Services (S)							.12	.25
Craftsman (Cr)								.70
Electronics Technician (ET)								

Note. — Table 10 was adapted from Gragg and Gordon (1951), p. 48.

[a]These data were obtained prior to the revision of the Radio Operator AI.

Revision of AC-1B

For approximately three years, AC-1B was used for the classification of enlisted personnel. In January 1953, a revised Radio Operator AI was introduced. Analysis of radio operator training had revealed that the selection of trainees on the basis of the original AC-1B Radio Operator composite was followed by a high rate of student attrition. The attrition was primarily due to the inability to learn International Morse Code. Research by Leiman (N 3) and Creager (1954) indicated that better prediction would be accomplished if the AI consisted of a measure of code learning ability and numerical and verbal tests. The Radio Operator AI was revised accordingly. As shown in Table 7, Electrical Information, Speed of Identification, and Memory for Landmarks were withdrawn from the composite. Word Knowledge and Army Radio Code (ARC) were added.

The final modification of AC 1B occurred in April of 1955. The Services AI had provided extremely low validities for the job specialties against which it had been validated. As a result, it was withdrawn from the battery and the job specialties included in the Services cluster were combined with those in the Technician Specialty cluster.

V. AIRMAN CLASSIFICATION BATTERY, AC-2A

In January 1956, Airman Classification Battery, AC-2A, became the operational classification device. Important changes in test content and AIs were introduced by the battery. Air Force job specialties had been resolved into five major clusters: Mechanical (M), Administrative (A), Radio Operator (RO), General (G), and Electronics (E). The predictive composite associated with each cluster consisted of newly developed subtests and aptitude measures from prior batteries. The stanine standard score employed with previous batteries was superseded by a modified percentile score.

Description

AC-2A consisted of fifteen subtests presented in five separate parts. BI keys were weighted in the Mechanical, Administrative, and Electronics composites. The number of items, scoring formula, and the time limit for each subtest are presented in Table 11. A description of each instrument is included in Appendix A. Three pairs of subtests were scored as single units; thus, three BI keys and eleven aptitude measures formed the five AIs of battery AC-2A. Table 12 presents the test composition of each composite.

Battery Development

The primary goal in the development of battery AC-2A was to devise a classification instrument with maximum differential validity. Obviously, differential predictions were possible only if differences in the major aptitudes for each cluster actually existed. Validity studies for AC-1B had revealed high relationships among various job categories; consequently, a more effective specialty clustering was sought. Technical school criteria were analyzed by a number of different factor analytic techniques. The results were similar and conclusive. Optimally efficient classification could be accomplished by resolving Air Force specialties into five basic job clusters and developing separate predictive composites for each.

During the operational use of AC-1B, experimental tests were administered to basic airmen and subsequently validated against technical school criteria. In this manner, potentially useful aptitude measures were identified. The primary basis for the selection of any test variable was the extent to which it differentiated between job clusters.

For the Mechanical AI of AC-2A, measures of mechanical experience, mechanical comprehension and spatial visualization received positive weights. Validity studies had indicated that a measure of quantitative skill, Numerical Operations, was negatively correlated with technical school grades for courses in the Mechanical cluster. Consequently, it was assigned a negative weight for the composite in order to minimize the contribution of test-taking ability. The Mechanical cluster was comprised of the Equipment Operator, Craftsman, and Mechanical Job families of AC-1B.

Table 11. **Tests of Airman Classification Battery, AC-2A**

Part	Tests	Testing Time[a]	Number of Items	Scoring Formula
I	Biographical Inventory	60	188	R
II	Arithmetic Reasoning	35	40	R-W/3
	Verbal Test	15	50	R-W/3
	Mechanical Principles	12	15	R-W/3
	General Mechanics		30	R-W/3
		32[b]		
	Tool Functions[c]		20	R-W/4
	Gestalt Completion	12	12	R-W/4
	Gottschaldt Figures	5[d]	16	R-W/4
III	Technical Information	40	60	R-W/4
	Pattern Comprehension	12	20	R-W
	Pattern Analysis	20[e]	20	R-W
Speeded Operations	Clerical Matching	3	50	R-W
	Numerical Operations	6	80	R-W
Aural Code	Army Radio Code	17	150	R-W/2
	Rhythm	16	70	R

Note. — The total administration time (excluding breaks) is approximately 5 hours and 30 minutes. Table 11 was adapted from Lecznar and Davydiuk (19[illegible]), p. 8.

[a]Time limits are given in number of minutes of actual testing time.

[b]Mechanical Test: Mechanical Principles and General Mechanics were scored as a single unit.

[c]General Mechanics and Tool Functions were administered as a single unit.

[d]Figure Recognition: Gestalt Completion and Gottschaldt Figures were scored as a single unit.

[e]Pattern Analysis: Pattern Comprehension and Pattern Analysis were scored as a single unit.

For the Administrative composite, measures of verbal and quantitative skill received positive weights. Validity studies had indicated that a measure of mechanical comprehension, Tool Functions, was negatively correlated with technical school grades for courses in the Administrative cluster. As a result, it was negatively weighted in the Administrative AI in order to increase the separation between the Mechanical and Administrative composites. The Administrative job cluster consisted predominantly of those specialties included in the old Clerical job family.

The Radio Operator composite consited of verbal and quantitative measures and a revised aural code test. The code test was revised by the simple addition of a measure of rhythm discrimination based on research by Fleishman and Spratte (1954). The Radio Operator cluster consisted of the specialties included in the traditional Radio Operator career field.

The General composite superseded the Technician Specialty AI of AC-1B. It was primarily a measure of general intelligence including tests of verbal and quantitative skills and spatial visualization. The specialties included in the General cluster were from the old Technician Specialty and Services job families.

The Electronics index included measures of complex mechanical and physical comprehension, quantitative skill, and spatial visualization. The Electronics cluster was comprised of specialties from the Electronics Technician job family of AC-1B.

Table 12. **Test Composition of Each Aptitude Index of AC-2A**

Tests	Aptitude Indices				
	M	A	RO	G	E
Arithmetic Reasoning	-	--	-	X	X
Verbal Test	-	X	X	X	--
Mechanical Principles	X	-	--	-	--
General Mechanics	X	-	--	-	--
Tool Functions[a]	X	X	--	-	--
Gestalt Completion	X	-	--	X	-
Gottschaldt Figures	X	-	--	X	-
Clerical Matching	-	X	-	--	-
Numerical Operations[b]	X	X	X	-	--
Technical Information	-	-	--	-	X
Pattern Comprehension	-	-	--	-	X
Pattern Analysis	-	--	-	--	X
Army Radio Code	-	-	X	--	-
Rhythm	--	-	X	-	-
Biographical Inventory Keys[c]					
Mechanical (M)	X	-	--	-	--
Administrative (A)	--	X	--	-	--
Electronics (E)	-	--	-	--	X

Note. — Table 12 was adapted from Lecznar and Davydiuk (1960), p. 8.

[a]Tool Functions received a negative weight for the Administrative AI.

[b]Numerical Operations received a negative weight for the Mechanical AI.

[c]The BI is scored with a separate key for each AI in which it is weighted.

In addition, BI keys were developed for three AIs: Mecahnical, Administrative, and Electronics. The prediction of success in the Radio Operator and General clusters was not appreciably increased by the use of the BI. Traditionally, items had been chosen for each BI key on the basis of the degree to which they differentiated between high and low criterion performance. For the BI keys of AC-2A, an additional requirement was imposed. Items which were selected for inclusion in a key for any given cluster were required to discriminate between high and low criterion performance in that cluster and that cluster only. As a result, the BI keys provided discrimination both within and between job families and considerably increased the discriminative efficiency of the battery.

Norms

The norms developed for AC-2A, like previous batteries, were based on the World War II mobilization population. Since the World War II distribution of talent was defined in terms of the AGCT-1C, this test served as the reference instrument in the development of the norms. The equi-percentile method was employed based on a standardization sample consisting of 2,454 randomly selected basic trainees (Brokaw & Burgess, 1957). One of the more important changes introduced by AC-2A was the transition from a stanine to a modified percentile score metric. For the AIs of AC-2A, the standard score scale consisted of 20 units each of which divided the World War II distribution of talent into five percentile intervals. Each interval was represented by a number (01, 05, ... 95) which indicated the percentage of the reference population falling below the upper limit of that interval. For the test variables, a 9-unit percentile scale was employed. Each unit divided the reference population into 11% intervals with the exception of the interval 5 (the middle interval) which included 12%.

Reliability

Table 13 presents reliability estimates for each AI of AC-2A. The correlation of sums method was employed to derive the estimates. Test-retest reliability coefficients were derived for the BI keys; internal consistency reliability coefficients were computed for the remaining test variables. The reliabilities range from .87 to .93 with a median of .89.

Table 13. **Reliability Coefficients for the Aptitude Indices of AC-2A**
(N = 2,202 basic trainees)

Aptitude Index	Reliability
Mechanical	.91
Administrative	.89
Radio Operator	.87
General	.87
Electronics	.93

Note. — Table 13 was adapted from Brokaw and Burgess (1957), p. 13.

Validity

Battery AC-2A was validated against both technical school course grades and job performance criteria, as measured by the paper-and-pencil Airman Proficiency Test (APT). Table 14 presents corrected validity coefficients resulting from validation studies of 68 job specialties. Final school grade (FSG) and APT data were available for 46 of the specialties represented. The samples providing the FSG and APT data are the same within each specialty. In addition, correlations between the criterion measures are provided.

Table 14. **Validity Coefficients[a] for the Aptitude Indices of AC-2A Corrected for Restriction of Range**

Aptitude Index	Technical School Course	N	r_c FSG[b]	r_c APT[c]	r[d]
Mechanical	Outside Wire and Antenna Systems Installation and Maintenance Specialist	83	30	.34	.27*
	Communications Machine Repairman	164	.30	.49	.50
	Aircraft Hydraulic Repairman	248	.61	.63	.63
	Instrument Repairman	223	.59	.51	.61
	Mechanical Accessories and Equipment Repairman	143	.46	.48	.63
	Aircraft Mechanic	1,000	.61	.61	.60
	Jet Engine Mechanic	228	.57	.58	.73
	Reciprocating Engine Mechanic	456	.67	.69	.74
	Munitions Specialist	266	.56	61	.52
	Weapons Mechanic, Bomber	405	40	.60	.48
	Automotive Repairman	72	.43	.58	.60
	Ground Powered and Support Equipment Repairman	93	.58	.72	.51
	Airframe Repairman	125	.46	.44	.48
	Central Office Equipment Specialist (Manual)	88	.61		
	Nuclear Weapons Mechanical Specialist	164	.35		
Radio Operator	Ground Radio Operator	372	.54	.40	.39
	Radio Intercept Operator	206	.69	.58	.30
	Cryptographic Operator	148	.34		

Table 14 (*Continued*)

Aptitude Index	Technical School Course	N	r_c FSG[b]	r_c APT[c]	r[d]
General	Weather Observer	458	.70	.57	.55
	Air Route and Approach Control Operator	65	.66	.32	.49
	Control Tower Operator	176	.65	.25	.27
	Aircraft Landing Operator	76	.71	.58	.43
	Aircraft Control and Warning Operator	111	.73	.58	.49
	Cooking	206	.56	.41	.32
	Air Policeman	1,000	.64	.60	.57
	Intelligence Operations Specialist	82	.74		
	Apprentice Physiological Training Specialist	117	.43		
	Apprentice Medical Service Specialist	174	.43		
	Apprentice Medical Material Specialist	132	.24		
	Apprentice Dental Specialist	245	.70		
	Photo Interpretation Specialist	48	.59		
	Still Photographer	82	.69		
	General Instructor	167	.46		
	Electrician	147	.41		
	Heating Specialist	64	.11NS		
	Firefighter	64	.64		
	Parachute Rigger	70	.41		
	Air Freight Specialist	89	.32		
Administrative	Communications Center Specialist	396	.42	.49	.24
	Air Passenger Specialist	46	.57	.33*	.58
	Warehousing Specialist	343	.60	.47	.46
	Organizational Supply Specialist	309	.57	.41	.36
	Supply Records Specialist	252	.29	.48	.34
	Accounting and Finance Specialist	140	.55	.48	.34
	Accounting Specialist	102	.78	.52	.60
	Statistical Specialist	98	.44	.44	.52
	Administrative Clerk	89	.66	.35	.30
	Personnel Specialist	97	.43	.19NS	.41
	Freight Traffic Specialist	137	.46		
	Fuel Supply Specialist, Conventional Fuels	64	.16NS		
	Machine Accountant	48	.46		
Electronics	Aircraft Radio Repairman	343	.80	.75	.69
	Aircraft Electronic Navigation Equipment Repairman	125	.75	.69	.74
	Aircraft Electronics Countermeasures	66	.79	.74	.80
	Air Traffic Control Radar Repairman	70	.71	.74	.76
	Aircraft Control and Warning Radar Repairman	388	.69	.62	.70
	Radio Relay Equipment Repairman	316	.74	.66	.56
	Flight Facilities Equipment Repairman	68	.73	.62	.56
	Ground Communications Equipment Repairman, Light	396	.77	.74	.71
	Ground Communications Equipment Repairman, Heavy	144	.70	.66	.54
	Fire Control Systems Mechanic	158	.59	.61	.56
	Weapons Control Systems Mechanic	384	.52	.65	.57
	Turret Systems Mechanic	145	.43	.37	.44
	Photographic Repairman	144	.68	.63	.58
	Aircraft Electrical Repairman	651	.74	.61	.66
	Ground ECM Specialist	124	.79		
	Bomb Navigation Systems Mechanic	123	.23*		
	Weapons Control Systems Mechanic	29	.48		

Note. — Table 14 was adapted from Brokaw (1959a), pp. 4, 7, 8, 10, 12, and 13, and Brokaw (1959b), pp. 6 and 8.

[a]The validity coefficients indicated with an asterisk are significant at the .05 level, those indicated (NS) are not statistically significant. All other validities are significant at the .01 level.

[b]FSG Final School Grade.

[c]APT Airman Proficiency Test.

[d]The correlation between FSG and APT.

For FSG, the validities range from .11 to .80 with a median of .57. For APT, the validities range from .19 to .75 with a median of .58. The correlations between FSG and APT range from .24 to .80 with a median correlation of .54.

Evaluation

Norms. The norms for AC-2A were based on the World War II normative reference base. The technique of developing norms for AC-2A on the basis of those developed for AGCT-1C has certain limitations. Angoff (1966) and Ghiselli (1964, p. 94) indicate that the value of the norms resulting from this procedure is dependent on the degree of the relationship between the two instruments, the reference instrument, and the instrument for which the norms are being developed. The correlations between the AGCT-1C and the AIs of AC-2A were as follows: Mechanical, .38; Adminstrative, .71; Radio Operator, .64; General, .84; and Electronics, .74 (Brokaw & Burgess, 1957). Since approximations of norms from a representative sample are eminently better than norms based on an unrepresentative sample, the norms for AC-2A were of considerable value. However, due to the low correlation between the AGCT-1C and the Mechanical AI, the norms for the Mechanical index may not have accurately represented those for AGCT-1C.

The new standard score metric, the percentile scale, introduced with AC-2A eliminated certain difficulties which developed from the use of the stanine scale. Brokaw and Burgess (1957) indicate that the adjustment of qualifying levels for various job specialties was extremely difficult due to the large number of individuals with intermediate stanine scores. For example, lowering a cut-off score from six to five qualified too many men for a job specialty and raising a score from five to six disqualified too many men. Accordingly, the percentile scale was implemented to permit the adjustment of qualifying levels by smaller increments.

Reliability. Based on the reliability coefficients presented in Table 13, it is evident that the AIs of AC-2A were sufficiently reliable for classification purposes.

Validity. For AC-2A, training and job performance criteria were available for validation. The validities are given in Table 14.

For FSG, the validities range from .11 to .80 with a median of .57. Of the 68 validities presented for FSG, only two were not statistically significant.

For APT, the validities range from .19 to .75 with a median of .58. Of the 46 validities presented for APT, all but two were significant at the .01 level.

Since FSG and APT data were available for validation, it was possible to establish the relationship between training and job performance criteria for the specialties represented. The median correlation ($r = .54$) indicates that substantial relationships existed between the training and job performance criteria. All correlations between FSG and APT were statistically significant.

The data of Table 14 indicate that the predictive efficiency of AC-2A was slightly lower than that for the previous batteries. Primarily, this was a result of employing negative weights and differential BI keys to increase the separation among the five AIs. The loss in a few points of average validity was considered necessary in order to devise a battery with maximum differential validity. There is no doubt that the instrument was of considerable value in the classification program. Based on the significant relationships between the training and job proficiency criteria, AC-2A was a valid basis for both training and job assignments.

Table 15 presents the intercorrelations of the AIs for AC-2A. The coefficients range from −.02 to .81. In relation to prior batteries, there is considerable independence among the AIs of AC-2A. The level of intercorrelations for AC-2A was substantially lower than that for the preceding batteries. For AC-1A, the median intercorrelation of the AIs was .82; for AC-1B, the median was .78; and for AC-2A, it was .57. The predictive composites of AC-2A provided considerable discrimination for purposes of differential predictions.

Table 15. **Intercorrelations of the Aptitude Indices of AC-2A**

(N = 2,202 basic trainees)

Aptitude Indices	**Aptitude Indices**				
	M	**A**	**RO**	**G**	**E**
Mechanical (M)		−.02	.26	.47	.56
Administrative (A)			.64	.72	.53
Radio Operator (RO)				.65	.58
General (G)					.81
Electronics (E)					

Note. – Table 15 was adapted from Brokaw and Burgess (1957), p. 13.

VI. AIRMAN QUALIFYING EXAMINATION, AQE-D

In 1958, the Air Force implemented a selective recruiting policy. The purpose of this new manpower procurement plan was to insure that the best potential enlistees were selected from the pool of available applicants.

Prior to selective recruiting, Air Force applicants were required to qualify on the Armed Forces Qualification Test (AFQT) in order to be enlisted. This Department of Defense selection instrument had been administered at main recruiting stations throughout the country. The airman classification batteries (AC-1A, AC-1B, and AC-2A) had been administered at Air Force basic training centers for the purpose of assigning enlistees.

The initiation of the selective recruiting policy affected the Airman Classification Program in two fundamental ways. First, the purpose of testing was extended to include both selection and classification. Air Force applicants were required to attain the fortieth percentile on at least one AI, of the classification battery, in order to be enlisted. This enlistment requirement was imposed in addition to qualifying on the AFQT. Furthermore, assuming that the applicants were qualified, they were assigned to career fields on the basis of the AIs of the same test battery. Second, Air Force Recruiting Service was given the responsibility for administering and scoring the classification battery. For a test battery to be appropriate for use at recruiting stations, it was necessary that it be hand-scorable and have a testing time of less than four hours. The airman classification battery (AC-2A) required a full day of testing time and was designed for machine-scoring; consequently, it was inappropriate for use at recruiting stations.

The Airman Qualifying Examination (AQE) had been designed to be a short version of the airman classification battery. It was originally designated AQE-A and was intended for use as a screening test to accompany AC-1A; however, it was never used operationally for this purpose. In 1949, it was printed as Airman Classification Test Battery-Permanent Party-1 (ACTB-PP-1) and was employed to obtain AIs on enlisted personnel who had entered the Air Force prior to the implementation of AC-1A. Subsequently, it was again designated as AQE-A and used as a substitute for AC-1A when records indicated a lack of AIs or the need for a retest. In 1953, two new forms, AQE-B and AQE-C, were introduced as short versions of AC-1B. With the implementation of AC-2A, a new form, AQE-D, was developed (Lecznar & Davydiuk, 1960). Since AQE-D required only two and one-half hours of testing time and was designed for hand-scoring, it was accepted as the first operational selection-classification battery. AQE-D replaced AC-2A in April of 1958.

Description

AQE-D consisted of eleven aptitude tests which were presented in three separate parts. Table 16 presents the number of items and scoring formula for each test and the time limit for each part. The material included in each test is described in Appendix A. Four AIs were derived from various combinations of the eleven test variables. The AIs were used to predict success in each of the following job clusters: Mechanical (M), Administrative (A), General (G), and Electronics (E). Table 17 presents the subtests weighted in each composite.

Table 16. **Tests of Airman Qualifying Examination, AQE-D**

Part	Tests	Testing Time[a]	Number of Items	Scoring Formula
I	Clerical Matching[b]	3	50	R-W
II	Numerical Operations[b]	6	80	R-W
III	Arithmetic Reasoning	110	15	R
	Verbal Test		29	R
	Mechanical Principles		15	R
	General Mechanics		15	R
	Tool Functions		15	R
	Figure Recognition[c]		15	R
	Electrical Information		15	R
	Pattern Comprehension		16	R
	Technical Data Interpretation		10	R

Note. — The total administration time is approximately 2 hours and 15 minutes. Table 16 was adapted from Leeznar and Davydiuk (1960), p. 13.

[a]Time limits are given in number of minutes of actual testing time.

[b]Speed test.

[c]Figure Recognition was entitled Gestalt Completion in AC-2A.

Table 17. **Test Composition of Each Aptitude Index of AQE-D**

Tests	Aptitude Indices M	A	G	E
Clerical Matching	--	X	--	-
Numerical Operations[a]	X	X	-	--
Arithmetic Reasoning	-	X	X	X
Verbal Test	-	X	X	-
Mechanical Principles	X	--	-	--
General Mechanics	X	--	-	--
Tool Functions[b]	X	X	--	-
Figure Recognition[c]	X	-	X	--
Electrical Information	-	--	-	X
Pattern Comprehension	--	-	--	X
Technical Data Interpretation	-	--	-	X

Note. — Table 17 was adapted from Leeznar and Davydiuk (1960), p. 13.

[a]Numerical Operations receives a negative weight for the Mechanical AI.

[b]Tool Functions receives a negative weight for the Administrative AI.

[c]Figure Recognition was entitled Gestalt Completion in AC-2A.

Battery Development

The tests included in AQE-D were designed to duplicate, as far as possible, those in AC-2A. Items for a majority of the tests were acquired from AC-1B; these item types included Numerical Operations, Tool Functions, Pattern Comprehension, Electrical Information, Arithmetic Reasoning, General Mechanics, and Mechanical Principles. Items for Figure Recognition and Clerical Matching were taken from AC-2A. The Verbal Test consisted of items selected from an experimental alternate form of AC-1B. Technical Data Interpretation was adapted from the Aviation Cadet Qualifying Test (PRT 3, September 1950). Table 18 presents the correlations between similar test variables of AQE-D and AC-2A. All correlation coefficients are significant at the .01 level.

Table 18. **Correlations[a] between Test Variables of AC-2A and AQE-D**

(N = 1,177 basic trainees)

AQE-D Variables	r	AC-2A Variables
Clerical Matching	.64[b]	Clerical Matching
Numerical Operations	.80	Numerical Operations
Tool Functions	.72	Tool Functions
Arithmetic Reasoning	.75	Arithmetic Reasoning
Pattern Comprehension	.70	Pattern Analysis[c]
Figure Recognition	.54	Gestalt Completion[d]
Electrical Information	.68	Technical Information[e]
General Mechanics	.73	Mechanical Principles[f]
Verbal Test	.85	Verbal Test
Mechanical Principles	.64	Mechanical Principles

Note. — Table 18 was adapted from Thompson (1958b), pp. 5-6.

[a]All correlation coefficients are significant at the .01 level.

[b]This correlation was derived from an independent sample of basic trainees; N = 1,083.

[c]Pattern Comprehension from AC-2A was not available for this study; Pattern Analysis was substituted in its place.

[d]Figure Recognition and Gestalt Completion are different names for the same instrument.

[e]Electrical Information items were included in the Technical Information subtest of AC-2A along with items concerning physical principles.

[f]General Mechanics from AC-2A was not available for this study; Mechanical Principles was substituted in its place.

AQE-D test variables were combined to be equivalent to four of the five AIs of AC-2A. Table 19 presents a comparison of the test components included in each AI of AQE-D and AC-2A. Since the Radio Operator AI of AC-2A was directed at an extremely small group of specialties, it was omitted. All personnel entering Radio Operator specialties were first prescreened on the Administrative AI and then were required to attain a qualifying score on the Radio Operator composite which was administered separately.

Norms

For AQE-D, standard scores were expressed as percentile. The AIs were obtained directly from converted raw composite scores; consequently, it was unnecessary to develop norms for each individual subtest. The norms for the AIs of AQE-D were tied in to those developed for AGCT-1C. The equipercentile method was employed with AC-2A as the reference instrument. The standardization sample consisted of 2,354 randomly selected basic trainees (Thompson, 1958a).

Table 19. **Comparison of the Aptitude Indices[a] of AC-2A and AQE-D**

Tests	Aptitude Indices M	A	G	E
Biographical Inventory	2A	2A	--	2A
Arithmetic Reasoning	--	D	2A,D	2A,D
Verbal Test	--	2A,D	2A,D	--
Mechanical Principles	2A,D	--	--	--
General Mechanics	2A,D	--	--	--
Tool Functions	2A,D	2A,D	--	--
Figure Recognition	2A,D	--	2A,D	--
Gottschaldt Figures	2A	--	2A	--
Clerical Matching	--	2A,D	--	--
Numerical Operations	2A,D	2A,D	--	--
Electrical Information[b]	--	--	--	2A,D
Pattern Comprehension	--	--	--	2A,D
Pattern Analysis	--	--	--	2A
Technical Data Interpretation	--	--	--	D

Note. — Table 19 was adapted from Thompson (1958a), p. 3.

[a]"2A" indicates inclusion in AC-2A; "D" indicates inclusion in AQE-D;

[b]Electrical Information was included in Technical Information of AC-2A along with additional questions concerning physical principles.

Reliability

Table 20 presents reliability estimates for the AIs of AQE-D. The coefficients range from .76 to .83 with a median of .81. Each estimate represents the correlation between similar AIs for AQE-D and AC-2A.

Table 20. **Reliability Coefficients for the Aptitude Indices of AQE-D**
(N = 1,777 basic trainees)

Aptitude Index	Reliability
Mechanical	.80
Administrative	.76
General	.81
Electronics	.83

Note. — Table 20 was adapted from Leczna (1963), p. 21.

Validity

For AQE-D, correlation techniques were employed to produce single validity estimates for three of the four AIs (Thompson, 1958b). Technical school grade served as the criterion. The corrected validity for the Mechanical AI and Aircraft and Engine Maintenance was .50 (N = 251). The corrected validity for the General AI and Air Traffic Control and Warning Operator was .47 (N = 94). For the Electronics AI and Radio and Radar Systems Mechanic, the corrected validity was .46 (N = 182). Each validity coefficient is significant at the .01 level.

Evaluation

Norms. The norms for AQE-D were tied back to the World War II mobilization base by the equi-percentile procedure with AC-2A serving as the reference instrument. Since the standardization sample was sufficiently large and the normative base was unquestionably representative, it is likely that the norms for AQE-D were a meaningful basis for score comparisons.

Reliability. Lecznar (1963) reported the reliability of the AQE-D as represented by the correlations between similar AIs of AC-2A and AQE-D. It is important to note that the reliabilities presented in Table 20 are not technically alternate form reliabilities, since the number of items differs for the two instruments. However, they do indicate that similar functions are measured by AQE-D and AC-2A.

Validity. Validation data for AQE-D were insufficient. The instrument was validated for only one job specialty in three of the four job clusters. Although all three of the validity coefficients obtained were statistically significant, decisive conclusions concerning the validity of AQE-D are not possible.

Since classification was one of the major functions of AQE-D, it was necessary to establish the differential validity of the instrument. As in AC-2A, negative weights were employed for the Mechanical and Administrative composites to increase the separation among the four AIs. Table 21 presents comparisons of the composite score intercorrelations for AC-2A and AQE-D. The difference obtained between the intercorrelations for corresponding AIs across the two batteries were not statistically significant. Apparently, the differentiation provided by AQE-D was equivalent to that of AC-2A.

Table 21. **Intercorrelations[a] of the Aptitude Indices for AC-2A and AQE-D**
(N = 1,777 basic trainees)

Aptitude Indices		M	A	G	E
Mechanical	AC-2A-M		.00	.50	.57
	AQE-D-M		.04	.55	.57
Administrative	AC-2A-A			.69	.52
	AQE-D-A			.63	.51
General	AC-2A-G				.82
	AQE-D-G				.77
Electronics	AC-2A-E				
	AQE-D-E				

Note. — Table 21 was adapted from Thompson (1958a), p. 6.

[a]The differences between the intercorrelations for corresponding AIs across the two batteries are not statistically significant.

VII. AIRMAN QUALIFYING EXAMINATION, AQE-F

Airman Qualifying Examination (AQE-F) replaced AQE-D in November of 1960. The test variables employed for AQE-F were identical to those for AQE-D with one exception; Hidden Figures replaced Figure Recognition in the Mechanical and General composites. The AIs of AQE-F were equivalent to those of AQE-D with the exception of the elimination of Numerical Operations in the Mechanical index and Tool Functions in the Administrative index.

Description

AQE-F consisted of eleven aptitude tests presented in three separate parts. Table 22 presents the number of items and scoring formula for each test and the time limit for each part. From the eleven aptitude measures, four AIs were derived. Table 23 presents the test composition of the four predictive composites. Appendix A contains a description of the material included in each test.

Table 22. **Tests of Airman Qualifying Examination, AQE-F**

Part	Tests	Testing Time[a]	Number of Items	Scoring Formula
I	Clerical Matching[b]	3	50	R-W
II	Numerical Operations[b]	6	80	R-W
III	Arithmetic Reasoning	110	15	R
	Verbal Test		29	R
	Mechanical Principles		15	[illegible]
	General Mechanics		14	R
	Tool Functions		15	R
	Hidden Figures[c]		16	R
	Electrical Information		15	R
	Pattern Comprehension		16	R
	Technical Data Interpretation		10	R

Note. — The total administration time is approximately 2 hours and 15 minutes. Table 22 was adapted from Leeznar (1963), p. 7.

[a]Time limits are given in number of minutes of actual testing time.

[b]Speed tests.

[c]Hidden Figures was entitled Gottschaldt Figures in AC-2A.

Table 23. **Test Composition of Each Aptitude Index of AQE-F**

Tests	Aptitude Indices M	A	G	E
Clerical Matching	--	X	--	--
Numerical Operations	--	X	--	--
Arithmetic Reasoning	--	X	X	X
Verbal Test	--	X	X	--
Mechanical Principles	X	--	--	--
General Mechanics	X	--	--	--
Tool Functions	X	--	--	--
Hidden Figures	X	--	X	--
Electrical Information	--	--	--	X
Pattern Comprehension	--	--	--	X
Technical Data Interpretation	--	--	--	X

Note. — Table 23 was adapted from Leeznar (1963), p. 7.

Battery Development

AQE-F was originally designated AQE-E and was designed to be an alternate form of AQE-D. The test variables included were identical to those in AQE-D with one exception; Hidden Figures replaced Figure Recognition. The items for all but two test variables were selected from new item pools obtained by contract. Clerical Matching and Numerical Operations were comprised of items taken directly from Chinese Air Force tests measuring the same abilities. The test variables were combined to duplicate the predictive composites represented in AQE-D. The AIs included the assignment of negative weights to Tool Functions for the Administrative composite and Numerical Operations for the Mechanical composite. Subsequently, experience in the Selective Recruiting Program resulted in the elimination of the negative for the two AIs. After this final modification, AQE-E was redesignated AQE-F.

The decision to eliminate the negative weights in the Mechanical and Administrative AIs reflected a change in testing strategy resulting from the extension of the battery purpose to include selection. When the battery was used only for classification, differential validity was the prime concern. However, with the initiation of the Selective Recruiting Program, the battery was used to select people from the manpower pool. As a result, it was necessary to sacrifice some differential validity in favor of maximum validity.

Norms

The standard scores used with AQE-F were in percentile form as in AQE-D. The norms were established by the equi-percentile procedure with AC-2A as the reference measure. Consequently, the norms for AQE-F were tied back to the distribution of talent represented by the World War II mobilization base. The standardization sample consisted of 2,428 randomly selected basic trainees (Thompson, 1958a).

Reliability

Table 24 presents test-retest reliability coefficients for each AI of AQE-F. The reliability estimates range from .81 to .88 with a median of .83.

Table 24. **Reliability Coefficients for the Aptitude Indices of AQE-F**
(N = 681 basic trainees)

Aptitude Index	Reliability
Mechanical	.83
Administrative	.88
General	.81
Electronics	.82

Note. — Table 24 was adapted from Lecznar (1963), p. 21.

Validity

The criterion used for the validation of AQE-F was technical school course grade. Correlation techniques were employed to produce the 41 validities presented in Table 25. All coefficients were corrected for the restriction incident to selection (AFQT) for training. The validities range from .28 to .90 with a median of .63.

Evaluation

Norms. The procedure followed in the development of the norms for AQE-F was similar to that for previous batteries. Since the standardization sample was of sufficient size and the normative base was unquestionably representative, it is likely that the derived norms were of significant value.

Table 25. **Validity Coefficients[a] for the Aptitude Indices of AQE-F Corrected for Restriction of Range**

Aptitude Index	Technical School Course	N	r_c
Mechanical	Aircraft Mechanic (Reciprocating)	770	.66
	Aircraft Mechanic (Jet, 1 and 2 engines)	1,723	.58
	Aircraft Mechanic (Jet, over 2 engines)	1,909	.57
	Jet Engine Mechanic	498	.61
	Reciprocating Engine Mechanic	502	.60
	Aircraft and Missile Pneudraulic Repairman	348	.63
	Mechanical Accessories and Equipment Repairman	164	.67
	Automotive Repairman	233	.58
	Airframe Repairman	198	.53
	Electrician	185	.42
	Electrical Power Production Specialist	539	.73
	Cryogenic Fluids Production Specialist	30	.90
	Refrigeration Specialist	37	.84
	Fuel Specialist (Conventional)	445	.54
	Fire Protection Specialist	617	.58
	Missile Mechanic (Ballistic)	125	.68
	Weapons Mechanic	253	.70
Administrative	Communications Center Specialist	740	.66
	Morse Intercept Operator[b]	668	.28
	Ground Radio Operator[b]	475	.44
	Cryptographic Operator	185	.52
	Inventory Management Specialist	1,041	.48
	Organizational Supply Specialist	1,307	.71
	Warehousing Specialist	433	.53
	Chaplain Services Specialist	100	.36
	Administrative Specialist	1,350	.63
	Personnel Specialist	622	.63
	Accounting and Finance Specialist	419	.63
	Data Processing Machine Operator	443	.33
General	Weather Observer	214	.83
	Aircraft Control and Warning Operator (Manual)	282	.80
	Aircraft Control and Warning Operator (SAGE)	467	.67
	Electronic Intercept Operations Specialist	294	.65
	Air Policeman	2,233	.46
	Medical Helper	1,832	.63
Electronics	Aircraft Radio Repairman	112	.71
	Ground Communications Equipment Repairman	127	.79
	Aircraft Ground Equipment Repairman	427	.64
	Aircraft Instrument Repairman	242	.66
	Aircraft Electrical Repairman	622	.75
	Flight Control/Autopilot Systems Repairman	352	.61

Note. — Table 25 was adapted from McReynolds (1963), pp. 7 1?

[a]All validity coefficients are significant at the .01 level

[b]For assignment to these courses students must first qualify on the Administrative AI and then attain a qualifying score on the Radio Operator AI from additional testing.

Reliability. Test-retest reliability estimates for the AIs of AQE-F are presented in Table 24. The interval between test and retest was not documented. Nevertheless, it is likely that the AIs of AQE-F were sufficiently reliable for selection and classification purposes.

Validity. The measure of effectiveness of AQE-F was the validity of the various AIs for technical school course grades. Empirically derived job performance criteria were not available. The validities range from .28 to .90 with a median of .63. All validities reported in Table 25 are significant at the .01 level. AQE-F was a valid and useful basis for technical school assignments.

VIII. AIRMAN QUALIFYING EXAMINATION, AQE-62

AQE-62 replaced AQE-F in October of 1962. The major change resulting from revision concerned the arrangement of item types. The subtest format previously employed was superseded by a modified spiral omnibus format. Airman Arithmetic supplanted Clerical Matching and Numerical Operations in the Administrative composite; otherwise, the AIs remained the same.

Description

AQE-62 consisted of 10 aptitude tests presented in a single test booklet. The number of items and scoring formula for each measure are presented in Table 26. The total administration time was approximately 2 hours. Appendix A includes a description of the material in each subtest. Four AIs equivalent to those for AQE-F were formed from various combinations of the 10 test variables. Table 27 presents the subtests weighted in each composite.

Table 26. **Tests of Airman Qualifying Examination, AQE-62**

Tests	Number of Items	Scoring Formula
Airman Arithmetic	45	R-W
Arithmetic Reasoning	15	R
Word Knowledge	30	R
Mechanical Principles	15	R
General Mechanics	15	R
Tool Functions	15	R
Gottschaldt Figures	15	R
Electrical Information	15	R
Pattern Comprehension	16	R
Technical Data Interpretation	10	R

Note. – Table 26 was adapted from Edwards and Hahn (1962), p. 2.

Table 27. **Test Composition of Each Aptitude Index of AQE-62**

Tests	Aptitude Indices M	A	G	E
Airman Arithmetic	--	X	--	-
Arithmetic Reasoning	--	X	X	X
Word Knowledge	-	X	X	-
Mechanical Principles	X	--	-	--
General Mechanics	X	--	-	--
Tool Functions	X	-	--	-
Gottschaldt Figures	X	--	X	--
Electrical Information	-	--	-	X
Pattern Comprehension	--	-	--	X
Technical Data Interpretation	--	-	--	X

Note. – Table 27 was adapted from Edwards and Hahn (1962), p. 2.

Battery Development

Originally, AQE-62 was developed to be an alternate form of AQE-F. However, due to administration and scoring difficulties, the two speed tests (Clerical Matching and Numerical Operations) were eliminated. Airman Arithmetic, a power test which measured similar abilities, replaced these instruments in the administrative AI. New Items were constructed for Technical Data Interpretation and Airman Arithmetic. The items for the remaining tests were selected from Air Force item pools. Most of the item types were arranged in a spiral omnibus format with several item types intermingled and administered together. This item arrangement eliminated the need for separate timing of each subtest and insured that each examine would be exposed to the proper proportion of all item types. Since Gottschaldt Figures, Technical Data Interpretation, and Pattern Comprehension employed either charts, tables, or figures, they were presented as separate subtests.

Norms

For AQE-62, the percentile standard score metric was maintained. The norms were tied back to the World War II mobilization population by the equi-percentile method with AQF-F serving as the reference instrument. The standardization sample consisted of 2,428 randomly selected basic trainees (Edwards & Hahn, 1962).

Reliability

Table 28 presents test-retest reliability estimates for the AIs of AQE-62. The interval between testing was from two to four weeks for the majority of cases. The estimates range from .78 to .83 with a median of .80.

Table 28. **Reliability Coefficients for the Aptitude Indices of AQE-62**
(N = 1,193 basic trainees)

Aptitude Index	Reliability
Mechanical	.78
Administrative	.77
General	.83
Electronics	.81

Note. — Table 28 was adapted from Tupes (1965), p. 2.

Validity

The validity of AQE-62 for selection and classification purposes was inferred from the relationships obtained between the AIs of AQE-62 and AQE-F. The correlations obtained for similar indices based on the standardization sample were as follows. Mechanical, .75, Administrative, .76, General, .81, and Electronics, .81 (Edwards & Hahn, 1962).

Evaluation

Norms. The norms for AQE-62 were developed by procedures similar to those followed in the development of norms for previous batteries. Consequently, the norms were probably a valuable means of score comparisons. However, research by Lecznar (1962) raised some doubts concerning the future use of the World War II mobilization population as the normative reference base. Although no decisive conclusions were reached, there were indications that the World War II norms no longer accurately represented the distribution of talent displayed in the general population.

Reliability. The reliability coefficients presented in Table 28 were sufficient for intended purposes. However, there was a substantial drop in the reliability (r_{tt} = .77) of the Administrative AI as compared to that (r_{tt} = .88) for the same AI of the previous battery.

Validity. The value of AQE-62 as the operational selection and classification instrument was inferred from the relationships between AQE-62 and AQE-F. Although the relationships obtained between corresponding AIs for the two instruments indicate that similar functions were being measured, conclusive statements concerning the validity of AQE-62 cannot be made.

IX. AIRMAN QUALIFYING EXAMINATION, AQE-64

In November of 1964, AQE-64 replaced AQE-62. The revised battery presented several modifications. Aptitude measures which had previously appeared as distinct subtests were spiraled in with other item types. Arithmetic Computation, a separately timed speed test, replaced Airman Arithmetic. A major change was introduced in the derivation of the AIs; educational variables were weighted in each composite. In the standardization of AQE-64, rather than norming on the World War II mobilization population, norms for the Project TALENT national aptitude census battery were used as the normative reference base.

Description

AQE-64 consisted of ten aptitude measures presented in two separate parts. Part I was comprised of nine power tests arranged in a spiral omnibus format. Part II was a separately timed speed test. The number of items and scoring formula for each test and the time limit for each part are presented in Table 29. Generally, the test variables of AQE-64 were equivalent to those of AQE-62. Four AIs were derived from various combinations of the ten test variables. In addition, each composite score included bonus points based on the completion of five academic courses. Table 30 presents the test components weighted in each AI.

Table 29. **Tests of Airman Qualifying Examination, AQE-64**

Part	Tests	Testing Time[a]	Number of Items	Scoring Formula
I	Arithmetic Reasoning	105	16	R
	Word Knowledge		30	R
	Mechanical Principles		15	R
	General Mechanics		15	R
	Shop Practices[b]		15	R
	Hidden Figures		16	R
	Electrical Information		16	R
	Pattern Comprehension		18	R
	Data Interpretation[c]		10	R
II	Arithmetic Computation[d]	15	50	R

Note. — The total administration time is approximately 2 hours. Table 29 was adapted from Madden and Lecznar (1965), p. 3.

[a]Time limits are given in number of minutes of administration time.

[b]Shop Practices was entitled Tool Functions in AQE-62.

[c]Data Interpretation was entitled Technical Data Interpretation in AQE-62

[d]Speed test.

Table 30. **Test Composition of Each Aptitude Index of AQE-64**

Tests	M	A	G	E
	Aptitude Indices			
Arithmetic Computation	--	X	--	--
Arithmetic Reasoning	--	X	X	X
Word Knowledge	--	X	X	X
Mechanical Principles	X	--	--	--
General Mechanics	X	--	--	--
Shop Practices	X	--	--	--
Hidden Figures	X	--	X	--
Electrical Information	--	--	--	X
Pattern Comprehension	--	--	--	X
Data Interpretation	--	--	--	X

Note. — Table 30 was adapted from Madden and Lecznar (1965), p. 3.

Battery Development

Three major changes were accomplished by battery revision. The first modification concerned the introduction of a new subtest, Arithmetic Computation. In AQE-62, a power test of quantitative skill, Airman Arithmetic, was spiraled with other test variables. This modification subsequently resulted in test administration problems. Reports from Test administrators indicated that examinees took too much time working simple arithmetic items and neglected items at the end of the battery. This problem was solved in the development of AQE-64. Pacing directions were added to the administration instructions and Airman Arithmetic was replaced by Arithmetic Computation, a separately timed speed test.

The second major modification consisted of spiraling item groups from Hidden Figures, Technical Data Interpretation and Pattern Comprehension which had appeared as distinct subtests in AQE-62. Not every item could be separated since two or more questions were related to the same pictorial presentation. However, it was possible to collapse each test into smaller units consisting of items related to a single figure and spiral the units in with the other item types.

The third major change concerned the derivation of the AIs. Research by Judy (1960) and Brokaw (1963) indicated that the use of educational information in conjunction with aptitude data would increase the predictive efficiency of the battery. Accordingly, multiple correlation techniques were employed to determine the credit values for completion of five high school courses for each AI. The courses were algebra, geometry, trigonometry, physics, and chemistry. Table 31 presents the course credit values for each composite. The bonus points were simply added to the raw composite scores prior to conversion to standard scores.

Table 31. **Course Credit Values for Each Aptitude Index of AQE-64**

Course	M	A	G	E
	Aptitude Indices			
Algebra	2	3	0	2
Geometry	4	3	3	0
Trigonometry	4	3	5	4
Physics	2	3	2	4
Chemistry	2	0	2	0

Note. — Table 31 was taken from Madden and Lecznar (1965), p. 8.

Technical Data Interpretation and Airman Arithmetic were developed from newly constructed items. Items for the remaining test variables were drawn from Air Force item pools. The criteria for item selection were mean item difficulty level, a limit of acceptance based on a percentage of the maximum phi coefficient, and face validity.

Norms

Research by Lecznar (1962) suggested the possibility that the World War II norms for the AGCT-1C were no longer representative of the level of aptitude displayed in the general population. Consequently, the World War II norms were replaced with those resulting from Project TALENT as the normative reference base.

With the help of several government agencies, the research effort known as Project TALENT was carried out by the University of Pittsburgh and the American Institute for Research. The primary objective was "the identification, development and utilization of human talents" (Dailey, Shaycoft, & Orr, 1962, p. 1). In the spring of 1960, a stratified random sample of 400,000 high school students (grades 9 through 12) were tested with a comprehensive battery of aptitude, achievement, background, interest, and personality tests. The sample was drawn from 1,300 secondary schools (public, private, and parochial), approximately 5% of all the secondary schools in the nation (Flanagan, Dailey, & Shaycoft, et al., 1960). The resulting norms for 12th grade males were employed as the normative reference base in the development of the standard scores for AQE-64.

From the Project TALENT battery, subsets of tests were derived by multiple correlation techniques which best represented the content and variance of each AQE composite (Dailey et al., 1962). These TALENT test composites served as reference measures in order to tie in the norms for the AIs of AQE-64 with those developed for TALENT. The equi-percentile method was employed based on a random sample consisting of 4,124 basic trainees (Madden & Lecznar, 1965). The percentile standard score metric was maintained.

Reliability

Reliability estimates for the AIs of AQE-64 were not available. However, since the battery was designed to replicate the content and variance of its predecessor, it was estimated that reliability coefficients for the various AIs would range from .80 to .90 (Madden & Lecznar, 1965, p. 9).

Validity

The validation of AQE-64 was accomplished by correlation techniques with technical school course grade as the criterion. Table 32 presents corrected validity coefficients for 57 separate technical school courses. The validities range from .38 to .87 with a median of .64.

Evaluation

Norms. The norms for AQE-64 were developed by the same technique employed in the standardization of previous batteries. However, instead of using the AGCT-1C as the reference instrument, subsets of Project TALENT tests were employed to tie in the norms for AQE-64 with those resulting from TALENT. Consequently, a measure of the value of the norms for AQE-64 is the relationships between the AQE and TALENT composites. For the Mechanical, Administrative, General, and Electronics composites, the correlations were, respectively, .78, .71, .86, and .83 (Madden & Lecznar, 1965, pp. 21, 23, 25, and 27). Educational variables were included in the derivation of both AQE and TALENT composites. Based on the obtained relationships, it is likely that the AQE-64 norms were useful approximations of those for Project TALENT.

Reliability. Actual reliability coefficients for the AIs of AQE-64 were not available. However, Madden and Lecznar (1965) estimated that the coefficients would range from .80 to .90. The correlations between similar AIs of AQE-62 and AQE-64 were Mechanical, .76; Administrative, .80; General, .82; and Electronics, .78 (Madden & Lecznar, 1965, pp. 21, 23, 25, and 27). These coefficients indicate that similar functions were being measured by the two forms of the AQE. It is likely that the AIs of AQE-64 provided a reliable means of selecting and classifying Air Force applicants.

Table 32. **Validity Coefficients[a] for the Aptitude Indices of AQE-64 Corrected for Restriction of Range**

Aptitude Index	Technical School Course	N	r_c
Mechanical	Munitions Maintenance Specialist	947	.51
	Weapons Mechanic	1,855	.56
	Missile Mechanic	156	.78
	Electrical Power Production Specialist	481	.74
	Refrigeration and Air Conditioning Specialist	327	.69
	Air Cargo Specialist	304	.63
	Aircraft Loadmaster	575	.64
	Aircraft Propeller Repairman	239	.60
	Aircraft Pneudraulic Repairman	507	.60
	Aircraft Environmental Systems Specialist	366	.63
	Aircraft Fuel Systems Mechanic	305	.70
	Helicopter Mechanic	220	.64
	Aircraft Maintenance Specialist (Reciprocating)	1,144	.68
	Aircraft Maintenance Specialist (Jet, one and two engines)	4,076	.66
	Aircraft Maintenance Specialist (Jet, over two engines)	2,108	.61
	Aircraft Maintenance Specialist (Turbo-prop)	2,410	.69
	Aircraft Maintenance Specialist	698	.66
	Maintenance Scheduling Specialist	2,538	.65
	Reciprocating Engine Mechanic	219	.69
	Special Vehicle Repairman	152	.69
	Air Frame Repair Specialist	537	.69
	Pavement Maintenance Specialist	180	.57
	Plumber	193	.59
	Fire Protection Specialist	410	.49
Administrative	General Accounting Specialist	184	.74
	Disbursement Accounting Specialist	290	.74
	Communications Center Specialist	962	.56
	Air Passenger Specialist	229	.52
	Inventory Management Specialist	2,929	.44
	Chapel Management Specialist	156	.50
	Personnel Specialist	449	.41
General	Intelligence Operations Specialist	228	.87
	Weather Observer	414	.87
	Air Traffic Control Operator	696	.67
	Medical Specialist	698	.65
	Medical Helper	2,475	.74
	Medical Services Specialist	328	.46
	Audio Visual Helper	188	.45
	Fuel Specialist	493	.47
	Materiel Facilities Specialist	521	.38
	Aircrew Life Support Specialist	211	.64
Electronics	Air Traffic Control Radar Repairman	177	.60
	Radar Repairman	689	.61
	Radio Relay Equipment Repairman	888	.64
	Flight Facilities Equipment Repairman	174	.68
	Ground Radio Communication Equipment Repairman	1,365	.67
	Electronic Communications and Cryptographic Equipment Systems Repairman	160	.48
	Telephone Communications Systems Control Attendant	298	.57
	Weapons Control Systems Mechanic (32231P)	275	.56
	Automatic Flight Control Systems Specialist	297	.60
	Flight Simulator Specialist	164	.49
	Telephone Switching Equipment Repairman (Electro/Mechanical)	159	.66
	Communications and Relay Center Equipment Repairman (Electro/Mechanical)	538	.78
	Electrician	230	.74
	Aerospace Ground Equipment Repairman	1,067	.73
	Instrument Repairman	539	.77
	Aircraft Electrical Repairman	649	.62

Note. — Table 32 was adapted from Valentine (Note 5).

[a]All validity coefficients are significant at the .01 level.

Validity. In the validation of AQE-64, technical school course grade served as the criterion; empirically derived job performance criteria were not available. The validities presented in Table 32 range from .38 to .87 with a median of .64. All validity coefficients are significant at the .01 level. Based on the relationship obtained for training criteria and the AIs, it is evident that AQE-64 was a valid basis for technical school assignments.

X. AIRMAN QUALIFYING EXAMINATION, AQE-66

AQE-66 replaced AQE-64 in September of 1966. Only minor changes were accomplished through revision. Arithmetic Computation was presented as the first part of the battery instead of the last as in AQE-64. Although the battery was composed of new items, the test variables included in each AI remained the same.

Description

AQE-66 was comprised of ten test variables presented in two separate parts. Part I consisted of Arithmetic Computation. Part II consisted of nine power tests arranged in a spiral omnibus format. The number of items and scoring formula for each test and the time limit for each part are presented in Table 33. Four AIs were derived from various combinations of the ten test variables. In addition, each composite score included bonus points based on the completion of five academic courses. Table 34 presents the test components for each index. The courses weighted in the various composites corresponded to those employed for AQE-64.

Table 33. Tests of Airman Qualifying Examination, AQE-66

Part	Tests	Testing Time[a]	Number of Items	Scoring Formula
I	Arithmetic Computation[b]	8	60	R
II	Arithmetic Reasoning	105	16	R
	Word Knowledge		30	R
	Mechanical Principles		15	R
	General Mechanics		15	R
	Shop Practices		15	R
	Hidden Figures		16	R
	Electrical Information		15	R
	Pattern Comprehension		18	R
	Data Interpretation		10	R

Note. — The total administration time is approximately 2 hours. Table 33 was adapted from Vitola and Madden (1967), p. 2.

[a]Time limits are given in number of minutes of administration time.

[b]Speed test.

Table 34. **Test Composition of Each Aptitude Index of AQE-66**

Tests	Aptitude Indices M	A	G	E
Arithmetic Computation	--	X	--	--
Arithmetic Reasoning	--	X	X	X
Word Knowledge	--	X	X	--
Mechanical Principles	X	--	--	--
General Mechanics	X	--	--	--
Shop Practices	X	--	--	--
Hidden Figures	X	--	X	--
Electrical Information	--	--	--	X
Pattern Comprehension	--	--	--	X
Data Interpretation	--	--	--	X

Note. — Table 34 was adapted from Vitola and Madden (1967), p. 2.

Battery Development

Primarily, battery revision consisted of the selection of new items from Air Force item pools for each of the nine power tests. The criteria for item selection were those previously employed by Madden and Lecznar (1965) in the development of AQE-64. Items were selected on the basis of mean difficulty level, a limit of acceptance in terms of a percentage of the maximum phi coefficient, and face validity. The major change accomplished through revision concerned the arrangement of test variables. Field test administrators reported that the battery would be easier to administer if the speed test, Arithmetic Computation, was presented first instead of last. AQE-66 test booklets were revised in accordance with this suggestion.

Norms

As with previous batteries, AQE-66 employed the percentile standard score metric. The norms were developed to be equivalent to those resulting from Project TALENT. The equi-percentile procedure was followed with the TALENT test composites developed by Dailey et al., (1962) as reference measures. The standardization sample consisted of approximately 4,000 randomly selected basic trainees (Vitola & Madden, 1967).

Reliability

Table 35 presents test-retest reliability coefficents for the AI's of AQE-66. The interval between testing varied from several weeks to four months. The reliabilities range from .84 to .88 with a median of .87.

Table 35. **Reliability Coefficients for the Aptitude Indices of AQE-66**
(N = 1,076 basic trainees)

Aptitude Index	Reliability
Mechanical	.87
Administrative	.84
General	.86
Electronics	.88

Note. — Table 35 was adapted from Valentine (1968), p.3.

Validity

AQE-66 was validated by correlation techniques with technical school course grade as the criterion. Table 36 presents corrected validity coefficients for 46 separate courses. The validities range from .18 to .90 with a median of .68.

Table 36. **Validity Coefficients[a] for the Aptitude Indices of AQE-66 Corrected for Restriction of Range**

Aptitude index	Technical School Course	N	r_c
Mechanical	Aircraft Pneudraulic Repairman	115	.55
	Aircraft Fuel Systems Mechanic	66	.26*
	Aircraft Maintenance Specialist (Reciprocating Engine)	238	.71
	Aircraft Maintenance Specialist (Jet, 1 and 2 engines)	691	.55
	Aircraft Maintenance Specialist (Jet, over 2 engines)	302	.56
	Aircraft Maintenance Specialist (Turbo-prop)	271	.68
	Jet Engine Mechanic	485	.62
	Missile Mechanic	53	.71
	Munitions Maintenance Specialist	73	.63
	Weapon Mechanic	345	.59
	Vehicle Repairman	52	.79
	Air Frame Repair Specialist	150	.71
	Corrosion Control Specialist	51	.77
	Electrical Power Production Specialist	120	.47
	Air Cargo Specialist	170	.44
	Aircraft Loadmaster	83	.66
Administrative	Communication Center Specialist	215	.61
	Printer Systems Operator	91	.44
	Morse Systems Operator	84	.62
	Ground Radio Operator	215	.33
	Inventory Management Specialist	789	.75
	Disbursement Accounting Specialist	122	.18*
	Personnel Specialist	262	.58
General	Imagery Interpreter Specialist	116	.87
	Weather Observer	99	.90
	Air Traffic Control Operator	156	.72
	Aircraft Control and Warning Operator	133	.73
	Medical Service, Fundamentals	401	.76
	Medical Service Specialist	50	.84
	Protective Equipment Specialist	60	.62
	Fuel Specialist	150	.52
	Security Specialist	707	.67
Electronics	Aircraft Radio Repairman	114	.86
	Aircraft Electronic Navigation Equipment Repairman	138	.84
	Electronic Warfare Repairman	62	.84
	Aircraft Inertial and Radar Navigation Systems Repairman	71	.88
	Radio Relay Equipment Repairman	61	.89
	Ground Radio Communications Equipment Repairman	70	.90
	Electronic Communications and Cryptographic Equipment Systems Repairman	50	.62
	Telecommunications Control Specialist/Attendant	82	.88
	Weapon Control Systems Mechanic	60	.80
	Communications and Relay Center Equipment Repairman (Electro/Mechanical)	52	.74
	Aerospace Photographic Systems Repairman	66	.62
	Aerospace Ground Equipment Repairman	208	.81
	Instrument Repairman	68	.67
	Aircraft Electrical Repairman	134	.61

Note. — Table 36 was adapted from Vitola, et al. (1973), pp. 13, 14, and 15.

[a]All validity coefficients are significant at the .01 level, except those two validities indicated with an asterisk which are significant at the .05 level.

Evaluation

Norms. A measure of the value of the norms developed for AQE-66 is the relationship between the AIs of the battery and the corresponding TALENT composites. The correlations were as follows: Mechanical, .77; Administrative, .74; General, .84; and Electronics, .81 (Vitola & Madden, 1967). Based on the relationships obtained between AQE-66 and the norming reference measures, it is likely that the obtained norms were valuable approximations of those resulting form Project TALENT.

Reliability. The test-retest reliability coefficients presented in Table 35 indicate that the AIs of AQE-66 were sufficiently reliable for selection and classification purposes.

Validity. Since empirical job performance criteria were not available, technical school course grade was employed as the criterion in the validation of AQE-66. The validities presented in Table 36 range from .18 to .90 with a median of .68. All validities presented are statistically significant. There is no doubt that AQE-66 was a valid basis for technical school assignments; however, as with most of the predecessor instruments, the validity of the battery for actual job assignments depended on the strength of the relationships between training and job performance criteria.

XI. AIRMAN QUALIFYING EXAMINATION, AQE-J

In July of 1971, AQE-J superseded AQE-66. The only major change concerned the arrangement of item types. The items of the previous battery were arranged in a spiral omnibus format; for AQE-J, a subtest format was employed. Although the battery consisted of new items, the test variables and AIs duplicated those of AQE-66.

Description

AQE-J consisted of ten separate subtests; Table 37 presents the time limit, number of items, and scoring formula for each. From different combinations of the ten test variables, four AIs were derived. Table 38 presents the test components included in each composite. Appendix A includes a description of the material included in each test.

Table 37. **Tests of Airman Qualifying Examination, AQE-J**

Tests	Testing Time[a]	Number of Items	Scoring Formula
Arithmetic Computation[b]	6	60	R
Arithmetic Reasoning	25	16	R
Word Knowledge	10	30	R
Mechanical Principles	15	15	R
General Mechanics	9	15	R
Shop Practices	9	15	R
Hidden Figures	20	16	R
Electrical Information	9	15	R
Pattern Comprehension	12	18	R
Data Interpretation	13	10	R

Note. — The total administration time is approximately 2 hours and 30 minutes. Table 37 was adapted from Vitola et al. (1971), p. 2.

[a]Time limits are given in number of minutes of actual testing time.

[b]Speed test.

Table 38. **Test Composition of Each Aptitude Index of AQE-J**

Tests	Aptitude Indices M	A	G	E
Arithmetic Computation	--	X	--	--
Arithmetic Reasoning	--	X	X	X
Word Knowledge	--	X	X	--
Mechanical Principles	X	--	--	--
General Mechanics	X	--	--	--
Shop Practices	X	--	--	--
Hidden Figures	X	--	X	--
Electrical Information	--	--	--	X
Pattern Comprehension	--	--	--	X
Data Interpretation	--	--	--	X

Note. — Table 38 was adapted from Vitola et al. (1971), p. 2.

Battery Development

AQE-J was developed and introduced to prevent test item obsolescence and possible compromise. New items for each test were selected from Air Force item pools. The criteria for item selection were face validity, mean item difficulty level, and a limit of acceptance in terms of the maximum phi coefficient.

Battery revision also resulted in a change in item arrangement. The items of the previous battery were arranged in a spiral omnibus format with different item types appearing together. This type of item arrangement required that examinees rapidly change mental set in the process of testing (for example, a quantitative item immediately followed by a verbal item). In contrast, for AQE-J, similar items were presented as distinct subtests, allowing examinees any possible benefit to be derived from maintaining mental set.

Norms

For the norms of AQE-J, Project TALENT data served as the normative reference base. The norms were developed by the equi-percentile method based on a random sample of 3,936 basic trainees (Vitola, Massey, & Wilbourn, 1971). The TALENT test composites developed by Dailey et al., (1962) served as reference measures. Standard scores were expressed in percentile form.

Reliability

Table 39 presents reliability estimates for each AI of AQE-J. The correlation of sums method was employed to produce the estimates. Internal consistency reliability coefficients were computed for each subtest. The composite reliabilities range from .88 to .94 with a median of .91.

Table 39. **Reliability Coefficients for the Aptitude Indices of AQE-J**
(N = 3,936 basic trainees)

Aptitude Index	Reliability
Mechanical	.88
Administrative	.91
General	.94
Electronics	.90

Note. — Table 39 was adapted from Vitola et al. (1971), p. 3.

Validity

Validation studies for AQE-J were not performed. The validity of the instrument for selection and classification purposes was inferred from the relationship obtained between AQE-66 and AQE-J. Correlation coefficients for similar AIs of the two batteries were Mechanical, .82; Administrative, .69; General, .83; and Electronics, .84 (N = 3,396; Vitola et al., 1971).

Evaluation

Norms. It is likely that the norms developed for AQE-J accurately represented those for Project TALENT. The correlations derived for similar composites of AQE-J and TALENT were as follows: Mechanical, .82; Administrative, .84; General, .90; and Electronics, .86. These correlations were computed on the basis of the standardization sample (Vitola et al., 1971).

Reliability. The reliability coefficients presented in Table 39 indicate that the AIs of AQE-J were a reliable basis for the selection and classification of Air Force enlistees.

Validity. Conclusive statements concerning the validity of AQE-J cannot be made since direct evidence was not obtained. However, based on the relationships between similar composites of AQE-J and AQE-66, it is reasonable to assume that the AIs of AQE-J approximated the validity of corresponding AQE-66 composites.

XII. ARMED SERVICES VOCATIONAL APTITUDE BATTERY, ASVAB-3

In September of 1973, the Armed Services Vocational Aptitude Battery (ASVAB-3) superseded AQE-J and is the current operational instrument for the selection and classification of nonprior service enlistees. The ASVAB is composed of aptitude measures which are common to the classification batteries used by the Army, Navy, and Air Force and was originally designed for use in a joint services high school testing program.

Description

ASVAB-3 consists of nine aptitude measures presented in a subtest format. Table 40 presents the time limit, number of items, and scoring formula for each test. Appendix A contains a description of the material in each instrument. For Air Force use, four composite scores are derived from different combinations of differentially weighted tests. Table 41 presents the test composition of each AI.

Table 40. **Tests of Armed Services Vocational Aptitude Battery, ASVAB-3**

Tests	Testing Time[a]	Number of Items	Scoring Formula
Coding Speed[b]	7	100	R
Word Knowledge	10	25	R-W/3
Arithmetic Reasoning	25	25	R-W/3
Tool Knowledge	10	25	R-W/3
Space Perception	15	25	R-W/3
Mechanical Comprehension	15	25	R-W/3
Shop Information	10	25	R-W/3
Automotive Information	10	25	R-W/3
Electronics Information	10	25	R-W/3

Note. — The total administration time is approximately 2 hours. Table 40 was adapted from Vitola and Alley (1968), p. 3.

[a]Time limits are given in number of minutes of actual testing time.

[b]Speed test.

Table 41. **Test Composition of Each Aptitude Index of ASVAB-3**

Tests	Aptitude Indices M	A	G	E
Coding Speed	–	X	–	–
Word Knowledge	–	X	X	–
Arithmetic Reasoning	–	–	X	X
Tool Knowledge	X	–	–	–
Space Perception	–	–	–	X
Mechanical Comprehension	X	–	–	–
Shop Information	X	–	–	–
Automotive Information	X	–	–	–
Electronics Information	–	–	–	X

Note. — Table 41 was adapted from Vitola and Alley (1968), p. 3.

Battery Development

In 1962, the Air Force initiated a high school testing program. The purpose of the program was to provide school guidance counselors with aptitude information on their students and to identify potential Air Force enlistees. Bayroff and Fuchs (1970, p. 2) indicate that " when the Army and Navy sought to test in the high schools, each with its own test battery, the additional testing time required brought considerable resistance from the schools. If testing in the high schools for recruiting purposes by all the services was to survive, the testing time required would have to be reduced. A logical solution was all services to use the same battery."

In February of 1966, a joint services committee of measurement and evaluation experts was formed and given the responsibility for the development and standardization of a differential aptitude battery for use in a joint services high school testing program.

The primary goal in the development of the battery was to design aptitude measures which would provide adequate coverage of the content included in the classification batteries used by each of the separate services. Accordingly, the Army, Navy, and Air Force batteries were administered to a random sample of 3,900 military basic trainees (Bayroff & Fuchs, 1970). A counterbalanced order of administration was used to prevent possible practice effects. Intercorrelations for all test variables were computed and served as the basis for the selection of aptitude measures common to all three classification batteries. On the basis of these analyses, nine subtests were chosen and organized into a battery, the Armed Services Vocational Aptitude Battery.

Eight of the nine ASVAB subtests were composed of items selected from the Army, Navy, and Air Force batteries. The criteria for item selection were mean item difficulty level, a lower limit of acceptance in terms of item discrimination level, and content validity. The ninth subtest was a modification of the Army Coding Speed Test. The items for each of the nine test variables were arranged in ascending order of difficulty.

In September of 1968, ASVAB-1 was accepted for use in the High School Military Testing Program. During that same year, Vitola and Alley (1968) developed test composites from the nine subtests of ASVAB-1 for use in the Air Force Airman Selection and Classification Program. Linear regression techniques were employed to develop four AIs which duplicated the content and variance of the AIs of AQE-66. The correlations for similar AIs of the two batteries were as follows: Mechanical, .75; Administrative, .72; General, .84; and Electronics, .83. The subtest composition of each of the resulting

composites is presented in Table 41. Although high school course credit values were initially included in the AIs, research indicated only minor differences in validites produced by AIs which included education information and AIs which excluded education information. Consequently, in July of 1974, the use of course credit values in the computation of the four AIs was discontinued.

Since the introduction of ASVAB-1, three alternate forms have been developed. ASVAB-1 was initially used in the High School Testing Program and was subsequently replaced by ASVAB-2. In September of 1973, ASVAB-3 supplanted AQE-J in the Air Force Airman Selection and Classification Program. ASVAB-4 is essentially a back-up instrument for use in case of test compromise.

Norms

The norms for ASVAB-3 were developed on the basis of those resulting from Project TALENT. The equi-percentile method was employed with the TALENT test composites developed by Dailey et al. (1962) as the norming reference measures. The standardization sample consisted of 4,172 randomly selected basic trainees. The percentile standard score metric was maintained.

Reliability

Research establishing the reliability of ASVAB-3 has not been performed. However, reliability coefficients for the AIs of ASVAB-1 have been obtained and are presented in Table 42. The correlation of sums method was used to derive the estimates. Internal consistency reliability coefficients were computed for each of the subtests. The composite reliabilities range from .84 to .91 with a median of .89.

Table 42. **Reliability Coefficients for the Aptitude Indices of ASVAB-1**

(N = 4,371 basic trainees)

Aptitude Index	Reliability
Mechanical	.84
Administrative	.91
General	.86
Electronics	.91

Note. — Table 42 was adapted from Vitola and Alley (1968), p. 5.

Validity

Direct evidence concerning the validity of ASVAB-3 for the purpose of selecting and classifying Air Force applicants is not available. The 46 corrected validity coefficients presented in Table 43 were taken from a study by Vitola et al. (1971) in which ASVAB-1 was validated against technical school final course grades. The validities range from .29 to .87 with a median of .68.

Evaluation

Norms. The value of the norms developed for ASVAB-3 is dependent on the strength of the relationship between ASVAB-3 and the norming reference measure. Correlations between similar composites for ASVAB-3 and TALENT are as follows: Mechanical, .82; Administrative, .70; General, .83; and Electronics, .80. Based on these relationships, it is likely that the norms for ASVAB-3 accurately represent those resulting from Project TALENT.

Reliability. The reliability of ASVAB-3 has not been established. In order to provide an indication of the reliability of the battery, reliability coefficients obtained for the AIs of an alternate form, ASVAB-1, were presented. Since the test variables included in all forms of the ASVAB are equivalent and the item selection techniques were the same, it is likely that ASVAB-1 and ASVAB-3 are highly related. However, since correlation coefficients representing the extent of the relationship have not been obtained, judgements concerning the reliability of the AIs of ASVAB-3 should be made with caution.

Table 43. **Validity Coefficients[a] for the Aptitude Indices of ASVAB-I Corrected for Restriction of Range**

Aptitude Index	Technical School Course	N	r_c
Mechanical	Aircraft Pneudraulic Repairman	115	.62
	Aircraft Fuel Systems Mechanic	66	.29*
	Aircraft Maintenance Specialist (Reciprocating Engine)	238	.67
	Aircraft Maintenance Specialist (Jet, 1 and 2 engines)	691	.55
	Aircraft Maintenance Specialist (Jet, over 2 engines)	302	.63
	Aircraft Maintenance Specialist (Turbo-prop)	271	.66
	Jet Engine Mechanic	485	.61
	Missile Mechanic	53	.67
	Munitions Maintenance Specialist	73	.55
	Weapons Mechanic	345	.53
	Vehicle Repairman	52	.82
	Air Frame Repair Specialist	150	.70
	Corrosion Control Specialist	51	.71
	Electrical Power Production Specialist	120	.64
	Air Cargo Specialist	50	.55
	Aircraft Loadmaster	50	.59
Administrative	Communication Center Specialist	215	.64
	Printer Systems Operator	91	.50
	Morse Systems Operator	84	.57
	Ground Radio Operator	215	.38
	Inventory Management Specialist	789	.75
	Disbursement Accounting Specialist	122	.37
	Personnel Specialist	262	.86
General	Imagery Interpreter Specialist	116	.86
	Weather Observer	99	.84
	Air Traffic Control Operator	156	.68
	Aircraft Control and Warning Operator	133	.83
	Medical Service, Fundamentals	401	.84
	Medical Service Specialist	50	.84
	Protective Equipment Specialist	60	.69
	Fuel Specialist	150	.54
	Security Specialist	707	.72
Electronics	Aircraft Radio Repairman	114	.86
	Aircraft Electronic Navigation Equipment Repairman	138	.82
	Electronic Warfare Repairman	62	.82
	Aircraft Inertial and Radar Navigation Systems Repairman	71	.85
	Radio Relay Equipment Repairman	61	.85
	Ground Radio Communications Equipment Repairman	70	.87
	Electronic Communications and Cryptographic Equipment Systems Repairman	50	.64
	Telecommunications Control Specialist/Attendant	82	.84
	Weapons Control Systems Mechanic	60	.75
	Communications and Relay Center Equipment Repairman (Electro/Mechanical)	52	.69
	Aerospace Photographic Systems Repairman	66	.59
	Aerospace Ground Equipment Repairman	208	.83
	Instrument Repairman	68	.67
	Aircraft Electrical Repairman	134	.64

Note. — Table 43 was adapted from Vitola, Mullins, and Croll (1973), pp. 8, 9, and 11.

[a]All validity coefficients are significant at the .01 level except the validity indicated with an asterisk which is significant at the .05 level.

Validity. Validation studies for ASVAB-3 have not been accomplished due to insufficient criterion data. Since it was necessary to provide some indication of the validity of the battery, validity coefficients obtained in the validation of ASVAB-1 were presented. The validities range from .29 to .87 with a median of .68. All validity coefficients presented are statistically significant. Technical school course grade served as the criterion; empirically derived job performance criteria were not available. It is evident that ASVAB-1 would have been a valid measure of technical school success. Nevertheless, the validity of ASVAB-3 for technical school assignments is dependent on the relationships obtained between the AIs of ASVAB-1 and ASVAB-3.

XIII. SUMMARY EVALUATION

Over the past 27 years, the Air Force has used ten different multiple aptitude batteries for the purpose of classifying nonprior service enlistees. Table 44 presents a chronological summary of the aptitude batteries used during this period of time. The first three batteries, AC-1A, AC-1B, and AC-2A, were used only for classification. The remaining batteries, AQE-D through ASVAB-3, were used for both selection and classification.

Norms

For AC-1A through AQE-62, norms were tied back to the World War II norms for AGCT-1C. Consequently, the norms for these batteries were based on the distribution of talent which appeared during mobilization conditions of World War II. For AQE-64 through ASVAB-3, norms were developed to be equivalent to those resulting from Project TALENT. Again, it was possible to develop norms on the basis of a normative reference group unusually large in size and unquestionably representative of the general population. Generally, norms for successive batteries were developed by the proper techniques with sufficiently large standardization samples and the means of referencing normative populations which allowed accurate and useful score comparisons.

Reliability

With very few exceptions, the reliability of the AIs for each of the multiple aptitude batteries has been sufficient. This is an especially commendable achievement since reliability is directly related to test length and the successive batteries have been progressively shortened. AC-1A required over five hours of testing time and AQE-J required two hours of testing time. Yet, the reliability of the AIs for the two batteries is very similar.

Validity

For AC-1A, AC-1B, AC-2A, AQE-F, AQE-64, and AQE-66, direct validity evidence was obtained based on the criterion of technical school grade. There is no doubt that these batteries were adequately valid for selection and classification purposes. For AQE-D, AQE-62, AQE-J, and ASVAB-3, validity was inferred from the relationships obtained between each respective battery and the preceding battery for which direct validity evidence was available. It is reasonable to assume that each of these batteries approximated the validity of predecessor instruments; however, decisive conclusions concerning their validity cannot be made.

Across all batteries, the most enduring problem encountered was the lack of an empirical job performance criterion for validation purposes. The customary solution to this problem was to employ the available intermediate criterion, typically technical school course grade. As a result, most of the batteries were valid for selection and technical school assignments, but the validity of the batteries for predicting successful job performance was an unknown. This aspect of validity depended on the relationship between technical school course grades and actual job performance. In spite of these difficulties, it appears that each of these batteries provided a viable basis for selection and training assignments.

Table 44. **Chronological Summary of Air Force Airman Classification Batteries**

Years																											
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Nov	Dec							Jan		Apr		Oct		Oct		Nov		Sep					Jul		Sep		
AC-1A				AC-1B					AC-2A		AQE-D		AQE-F		AQE-62		AQE-64			AQE-66				AQE-J		ASVAB-3	

REFERENCES

Angoff, W.H. Can useful general-purpose equivalency tables be prepared for different college admissions tests? In A. Anastasi (Ed.), *Testing problems in perspective.* Washington: American Council on Education, 1966, pp. 251-264.

Bayroff, A.G., & Fuchs, E.F. *The Armed Services Vocational Aptitude Battery.* TRR-1161. U.S. Army Behavior and Systems Research Laboratory, Alexandria, VA: February 1970.

Brokaw, L.D. *Prediction of Air Force training and proficiency criteria from Airman Classification Battery AC-2A.* WADC-TN-59-196, AD-228 445. Lackland AFB, Tex.: Personnel Laboratory, Wright Air Development Center, December 1959. (a)

Brokaw, L.D. *Prediction of criteria for medical and dental specialties from Airman Classification Battery AC-2A.* WADC-TN-59-202, AD-231 257. Lackland AFB, Tex.: Air Force Personnel and Training Research Center, December 1959. (b)

Brokaw, L.D. *Prediction of success in technical training from self-report information on educational achievement.* PRL-TDR-63-11, AD-414 888. Lackland AFB, Tex.: Personnel Research Laboratory, Aerospace Medical Division, April 1963.

Brokaw, L.D., & Burgess, C.G. *Development of Airman Classification Battery AC-2A.* AFPTRC-TR-57-1, AD-131 422. Lackland AFB, Tex.: Air Force Personnel and Training Research Center, June 1957.

Creager, J.A. *Comparative validation of two radio code tests when used with the Airman Classification Battery in selecting radio operator trainees.* AFPTRC-TR-54-65. Lackland AFB, Tex.: Air Force Personnel and Training Research Center, November 1954.

Dailey, J.T., Shaycoft, M.F., & Orr, D.B. *Calibration of Air Force selection tests to project TALENT norms.* PRL-TDR-62-6, AD-285 185. Lackland AFB, Tex.: Personnel Research Laboratory, Aerospace Medical Division, May 1962.

Edwards, D.S., & Hahn, C.P. *Development of Airman Qualifying Examination 62.* PRL-TDR-62-7, AD-284 775. Lackland AFB, Tex.: 6570th Personnel Research Laboratory, Aerospace Medical Division, May 1962.

Flanagan, J.C., Dailey, J.T., Shaycoft, M.F. et al. *Designing the study.* Project TALENT Monograph Series-Monograph No. 1. Pittsburg, PA: University of Pittsburgh, December 1960.

Fleishman, E.A., & Spratte, J.G. *The prediction of radio operator success by means of aural tests.* AFPTRC-TR-54-66. Lackland AFB, Tex.: Air Force Personnel and Training Research Center, November 1954.

Ghiselli, E.E. *Theory of psychological measurement.* New York: McGraw-Hill, 1964.

Gragg, D.B., & Gordon, M.A. *Validity of the Airman Classification Battery AC-1.* RB-50-3, 2nd ed. Lackland AFB, Tex.: Personnel Research Laboratory, Human Resources Research Center, September 1951.

Judy, C.J. *Appraisal of educational requirements for airmen specialties.* WADD-TN-60-264, AD-252 253. Lackland AFB, Tex.: Personnel Laboratory, Wright Air Development Division, December 1960.

Kelly, T.L. *Fundamentals of statistics.* Cambridge: Harvard University Press, 1947.

Lecznar, W.B. *Some aptitude data on Air Force enlisted accessions.* PRL-TDR-62-10, AD-289 874. Lackland AFB, Tex.: 6570th Personnel Research Laboratory, Aerospace Medical Division, June 1962.

Lecznar, W.B. *Survey of tests used in airman classification.* PRL-TDR-63-5. AD-403 831. Lackland AFB, Tex.: Personnel Research Laboratory, Aerospace Medical Division, February 1963.

Lecznar, W.B., & Davydiuk, B.F. *Airman classification test batteries. A summary.* WADD-TN-60-135, AD-240 831. Lackland AFB, Tex.: Personnel Laboratory, Wright Air Development Division, May 1960.

Lecznar, W.B., & Tupes, E.C. *Comparison of Air Force aptitude indices with corresponding TALENT test composites.* PRL-TDR-63-18, AD-420 555. Lackland AFB, Tex.: Personnel Research Laboratory, Aerospace Medical Division, August 1963.

Madden, H.L., & Lecznar, W.B. *Development and standardization of Airman Qualifying Examination 64.* PRL-TR-65-14, AD-622 807. Lackland AFB, Tex.: Personnel Research Laboratory, Aerospace Medical Division, August 1965.

Massey, I.H., & Creager, J.A. *Validation of the Airman Classification Battery: 1949-1953.* AFPTRC-TN-56-129, AD-098 903. Lackland AFB, Tex.: Air Force Personnel and Training Research Center, November 1956.

McReynolds, J. *Validity of Airman Qualifying Examination, Form F, for technical training grades – 1961.* PRL-TDR-63-20, AD-426 756. Lackland AFB, Tex.: Personnel Research Laboratory. Aerospace Medical Division, August 1963.

Thompson, C.A. *Development of the Airman Qualifying Examination, Forms D and E. Part I.* WADC-TR-58-94, II, AD-151 045. Lackland AFB, Tex.: Personnel Laboratory, Wright Air Development Center, August 1958. (a)

Thompson, C.A. *Development of the Airman Qualifying Examination, Forms D and E. Part II.* WADC-TR-58-94, II, AD-151 045. Lackland AFB, Tex.: Personnel Laboratory, Wright Air Development Center, August 1958. (b)

Thorndike, R.L. *Personnel selection.* New York: John Wiley & Sons, Inc., 1949.

Tupes, E.C. *AQE norms for high school seniors and Air Force training groups.* PRL-TR-65-10, AD-619 346. Lackland AFB, Tex.: Personnel Research Laboratory, Aerospace Medical Division, May 1965.

Uhlaner, J.E., & Bolanovich, D.J. *Development of Armed Forces Qualification Test and predecessor Army screening tests, 1946-1950.* PRS Report 976. Washington: Personnel Research Section, Personnel Research and Procedures Branch, the Adjutant General's Office, Department of the Army, November 1952.

Valentine, L.D. *Relationship between Airman Qualifying Examination and Armed Forces Qualifying Test norms.* AFHRL-TR-68-106, AD-678 528. Lackland AFB, Tex.: Personnel Research Division, Air Force Human Resources Laboratory, July 1968.

Vitola, B.M., & Alley, W.E. *Development and standardization of Air Force composites for the Armed Services Vocational Aptitude Battery.* AFHRL-TR-68-110, AD-688 222. Lackland AFB, Tex.: Personnel Research Division, Air Force Human Resources Laboratory, September 1968.

Vitola, B.M., & Madden, H.L. *Development and standardization of Airman Qualifying Examination 66.* PRL-TR-67-5, AD-661 996. Lackland AFB, Tex.: Personnel Research Laboratory, Aerospace Medical Division, August 1967.

Vitola, B.M., Massey, I.H., & Wilbourn, J.M. *Development and standardization of the Airman Qualifying Examination – Form J.* AFHRL-TR-71-28, AD-730 592. Lackland AFB, Tex.: Personnel Division, Air Force Human Resources Laboratory, May 1971.

Vitola, B.M., Mullins, C.J., & Croll, P.R. *Validity of Armed Services Vocational Aptitude Battery - Form 1 to predict technical school success.* AFHRL-TR-73-7, AD-767 578. Lackland AFB, Tex.: Personnel Research Division, Air Force Human Resources Laboratory, July 1973.

REFERENCE NOTES

1. **Brokaw, L.D.** *Personal Communication*, April 1975.

2. **Gordon, M.A.** *Validity of the Airman Classification Battery (AC-1A) for career guided samples.* RN-PERS-51-13, AD-76 537. Lackland AFB, Tex.: Human Resources Research Center, July 1951.

3. **Leiman, J.M.** *Effect on the predictive efficiency of the Airman Classification Battery when used in conjunction with an aural code test.* RN-PERS-52-33. Lackland AFB, Tex.: Human Resources Research Center, October 1952.

4. **Massey, I.H.** *Determination of optimal weights of tests of the Airman Classification Test Battery for maximum prediction of success in mechanics and electronics technical schools.* Unpublished Master's thesis, Southwest Texas State College, 1950.

5. **Valentine, L.D., Jr.** *Validity of Air Force enlisted classification majors.* Paper presented in a Symposium (Testing in the Military Personnel Systems) of the 76th Annual Convention of the American Psychological Association, 1968. (Available to qualified requestors from the Air Force Human Resources Laboratory, Personnel Research Division, Lackland AFB, Texas 78236.)

6. **Zachert, V., & Ivens, F.C.** *Fourteen Air Force technical school validity studies for the Airman Classification Battery AC-1B based on samples including Negroes and WAF.* RN-PERS-52-4, AD-76 652. Lackland AFB, Tex.: Human Resources Research Center, January 1952.

APPENDIX A: DESCRIPTION OF TESTS

Airman Arithmetic is a power test of simple addition, subtraction, multiplication, and division problems.

Arithmetic Computation is a speed test of simple arithmetic items involving addition, subtraction, multiplication, and division.

Arithmetic Reasoning consists of the verbal presentation of arithmetic problems entailing simple computations.

Army Radio Code is presented aurally. It employs a learning session during which examinees become familiar with the Morse Code letters I, N, and T. A simple recognition test follows. The task is to identify each of the coded letters.

Automotive Information is designed to evaluate specific knowledge about automobiles and automobile motors.

Aviation Information consists of general questions concerning aviation and aeronautics.

Background for Current Affairs consists of questions concerning military, economic, and diplomatic affairs. The questions cover both current and historic phases of the above categories.

Biographical Inventory consists of questions relative to the educational, vocational, and home background of the examinee. It is designed for scoring with empirically derived keys for various job clusters.

Clerical Matching is a test of clerical speed and accuracy requiring the examinee to match various pairs of symbols.

Coding Speed evaluates the examinee's ability to quickly and accurately assign coded numbers by relating them to specific words.

Data Interpretation. Refer to Technical Data Interpretation.

Dial and Table Reading is a speed test consisting of two parts. Dial Reading requires verification of a group of dial readings similar to those in an aircraft. Table Reading requires the determination of certain information by reading various mathematical tables. Both parts are scored together since they measure similar functions.

Electrical Information consists of questions concerning physical principles and electrical diagrams and attempts to measure the examinee's knowledge of basic electricity.

Electronics Information measures the ability to apply previously acquired knowledge in the areas of electricity and electronics toward the solution of problems in practical situations.

Figure Recognition. Refer to Gestalt Completion.

General Mechanics consists of questions which cover a broad range of topics concerning mechanical methods and devices.

Gestalt Completion consists of incomplete silhouettes of familiar objects. The task is simply to identify the objects.

Gottschaldt Figures presents geometric figures hidden within complex designs. The task is to identify the figures.

Hidden Figures. Refer to Gottschaldt Figures.

Mechanical Comprehension. Refer to Mechanical Principles.

Mechanical Principles consists of pictorially represented items which attempt to measure the ability to comprehend actions of mechanisms in motion and principles such as leverage, rotation, and transformation of motion underlying the use of various mechanical devices.

Memory for Landmarks attempts to measure rote memory. It consists of pictorial items representing various natural landmarks (rivers, lakes, and bays). The task is to recall the names of the landmarks upon representation after exposure to associated names and landmarks.

Numerical Operations is a speed test consisting of simple arithmetic problems involving division and subtraction.

Pattern Analysis presents solid figures and a number of flat patterns. The task is to identify the patterns which correspond to the solid figures.

Pattern Comprehension consists of pictorial presentations of folded and unfolded boxes, cylinders, and pyramids. Edges are numbered on unfolded figures; they are lettered on folded ones. The task is to match numbers on two dimensional figures with the letters on the three dimensional figures with which they correspond.

Rhythm is presented aurally. The examinee is required to listen to two consecutive patterns of sound. The task is to identify them as similar or dissimilar. A practice session consisting of five items is administered first.

Shop information. Refer to Tool Functions.

Shop Practices. Refer to Tool Functions.

Space Perception. Refer to Pattern Analysis.

Speed of Identification consists of a series of silhouettes representing various aircraft. Silhouettes representing the front, top, and side view of an aircraft are to be matched with other silhouettes representing the front, top, and side view of the same aircraft in a different flying attitude.

Technical Data Interpretation presents data in the form of charts and tables. The examinee is required to extract relevant information from the charts and tables for use in the solution of simple problems.

Technical Information consists of 30 academic physics vocabulary items, 10 mechanical movements items, and 20 general questions concerning science and electrical information.

Tool Functions is designed to measure familiarity with the use of various types of tools. Tools used in mechanics, plumbing, and machine work are pictorially presented. The task is to indicate how the tool is properly used.

Tool Knowledge is a pictorial test which requires the examinee to identify pictured tools and determine related items with which they are used.

Word Knowledge is a classic vocabulary test which requires that a stimulus word be matched with a meaningful alternative.

Verbal Test. Refer to Word Knowledge.

LIST OF ABBREVIATIONS

AC-1A – Airman Classification Battery, Form 1A
AC-1B – Airman Classification Battery, Form 1B
AC-2A – Airman Classification Battery, Form 2A
ACTB-PP-1 – Airman Classification Test Battery – Permanent Party, Form 1
AFQT – Armed Forces Qualification Test
AGCT-1C – Army General Classification Test, Form 1C
AQE-A – Airman Qualifying Examination, Form A
AQE-B – Airman Qualifying Examination, Form B
AQE-C – Airman Qualifying Examination, Form C
AQE-D – Airman Qualifying Examination, Form D
AQE-E – Airman Qualifying Examination, Form E
AQE-F – Airman Qualifying Examination, Form F
AQE-62 – Airman Qualifying Examination, Form 62
AQE-64 – Airman Qualifying Examination, Form 64
AQE-66 – Airman Qualifying Examination, Form 66
AQE-J – Airman Qualifying Examination, Form J
ASVAB-1 – Armed Services Vocational Aptitude Battery, Form 1
ASVAB-2 – Armed Services Vocational Aptitude Battery, Form 2
ASVAB-3 – Armed Services Vocational Aptitude Battery, Form 3
ASVAB-4 – Armed Services Vocational Aptitude Battery, Form 4
MA-2 – Army Mechanical Aptitude Test, Form 2
A – Administrative[1]
AI – Aptitude Index
APT – Airman Proficiency Test
BI – Biographical Inventory
Cl – Clerical[1]
Cr – Craftsman[1]
E – Electronics[1]
ET – Electronics Technician[1]
EO – Equipment Operator[1]
FSG – Final School Grade
G – General[1]
I – Technical Instructor[1]
M – Mechanical[1]
S – Services[1]
RO – Radio Operator[1]
TS – Technician Specialty[1]

[1]These titles signify both aptitude indices and job clusters.

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